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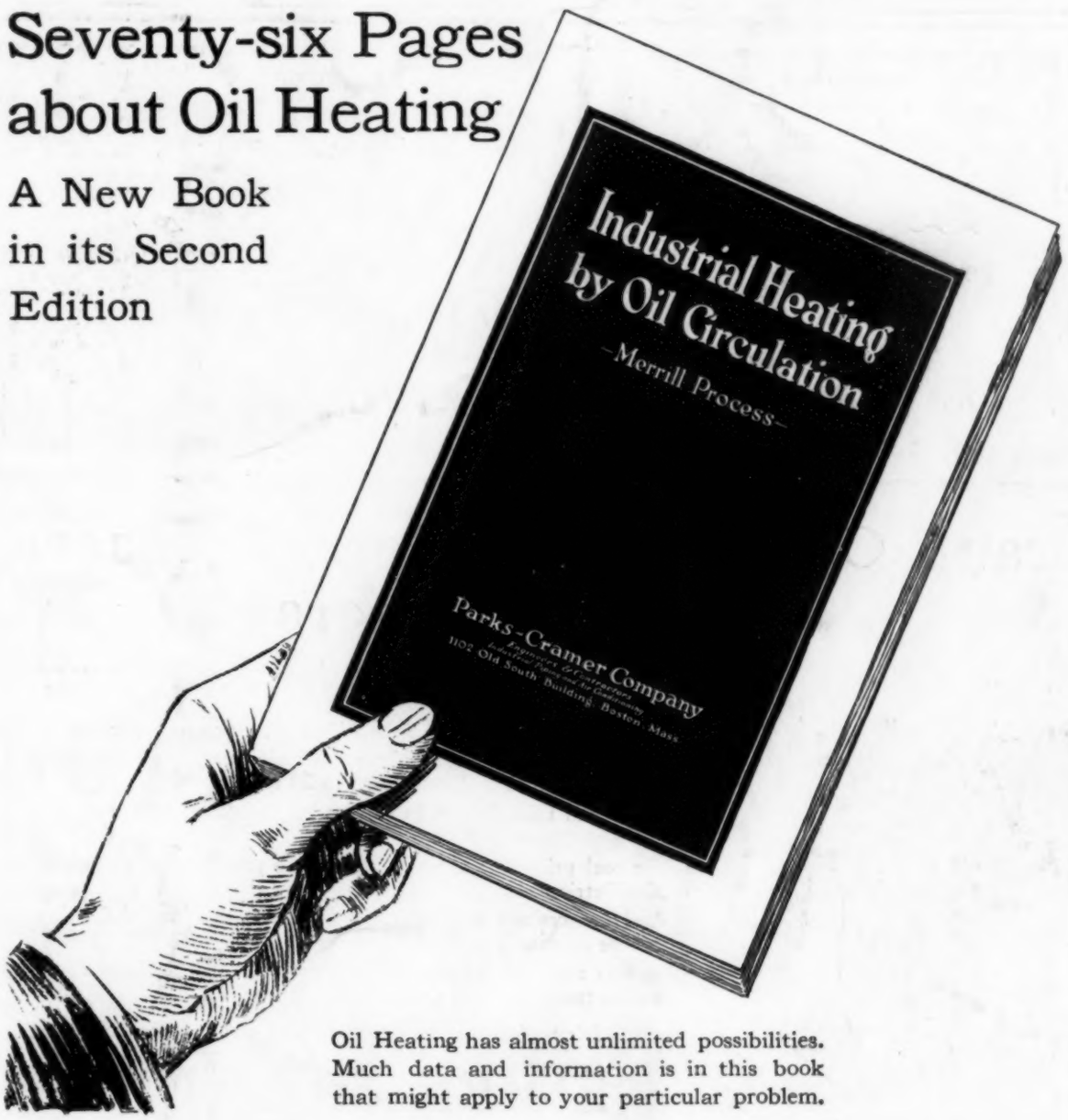

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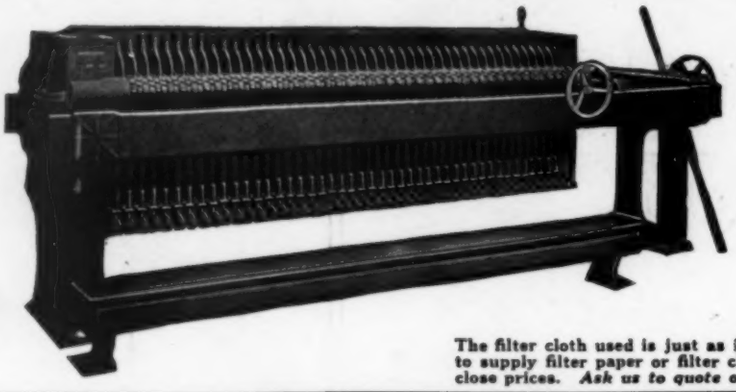

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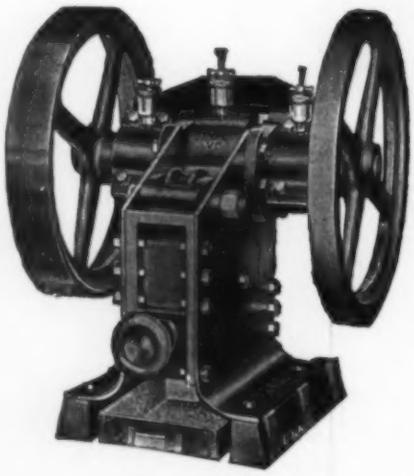

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Strengthening Our Consular Service

THERE was a time when we looked upon consuls and diplomats as a queer sort of gold-braided courtiers or pompous supernumeraries that had somehow been forced upon our government by time and Old World customs. That youthful impression was soon dissipated, however, when we were given a chance to learn something of the multifarious duties of these men who represent us in foreign lands. In reality they constitute an active field force on which we are largely dependent for furthering and protecting our commercial interests abroad. In this way they perform a day-by-day service which in its aggregate importance to our country far outweighs this occasional but widely heralded accomplishments in the field of international politics.

As a government and as individuals the world war drew us into many new international relationships. The field of our commercial activities was greatly extended and with this came a need for a broader and better understanding of foreign affairs. The consular and diplomatic services assumed a rôle of new importance. And it was the greater demand for these services that called attention to the serious handicaps under which our representatives are laboring. Unfortunately their organization is largely on a pre-war basis—entirely inadequate to meet the pressing requirements of the government alone without giving any attention to private or commercial interests. Furthermore, the salary scales are pitifully low. For instance, diplomatic secretaries acting as counselors of embassies such as those in London or Paris receive a maximum annual salary of $4,000 and important secretarial positions are filled by men to whom the government can pay but $2,500 to $3,000. The result is that these officials, even down to the lowliest attaché, must be recruited from the ranks of men of independent means. It is a difficult task, therefore, to find a sufficient number of men who are qualified to carry out effectively the responsible and highly important work of these positons—and at the same time are willing to make so severe a personal sacrifice.

For some reason or other the law has separated the consular and diplomatic services into what has been described as "watertight compartments." Transfer from one branch to another has been made impossible: not even in an emergency could a well-qualified diplomatic secretary take over the responsibilities of a consular post. So it goes. Benefits to be derived from efficient co-ordinated administration must be withheld simply because of an antiquated law that has long since outgrown its usefulness.

These three defects in our present system—organization, personnel and compensation—can be remedied in a large measure by legislation now pending in Congress. The bills introduced by Representative J. J. ROGERS have been designed to strengthen and modernize the entire field forces of the Department of State. They provide for a reclassification and reorganization of the consular and diplomatic services. A co-ordinated plan of administration offers possibilities for flexible and efficient service and, finally, salaries have been raised to a respectable standard. The bills endeavor to do this without a radical extension of government service or an extravagant appropriation of government funds. Rather it is proposed to put these services on a directly business-like basis so that the foreign affairs of governmental and private interest may be completely and efficiently handled. Surely such a program is worthy of the support of all who are interested in furthering American business abroad.

Benjamin Silliman And Yale's New Laboratory

HISTORIC significance is given to the date that has been chosen by Yale University for the dedication of the new Sterling chemistry laboratory. It seems that on April 4, 1804, the first lecture ever given on chemistry in Yale College was delivered by BENJAMIN SILLIMAN, SR. In commemoration of that event Yale's magnificent new laboratory will be formally dedicated on April 4, 1923, during the spring meeting of the American Chemical Society in New Haven.

It is interesting to trace the influence of SILLIMAN on the development of American chemistry. For 51 years he held the chair of chemistry and natural philosophy in Yale. Probably more than any other one man in America he served to popularize science, particularly chemistry and geology, and to interest and instruct thousands of persons outside the college walls. He traveled all over the United States during a period of 20 years, lecturing on scientific subjects to large audiences. In Boston more than fifteen hundred persons paid admission to a series of evening lectures; and the capacity of the hall being exceeded by the demands, he gave a series of afternoon lectures as well.

Professor SILLIMAN was never known as a great investigator and researcher. What he did was thorough; but his great service was in bringing science to the people, in stimulating an interest in the subject in his students and in all who heard him lecture. Coming at the very beginning of our life as a nation, there was need for just such service. As founder and editor of the *American Journal of Science*, he laid the foundation for other journals devoted to the physical sciences. It is due more to Professor SILLIMAN than to any other man that the Sheffield Scientific School of Yale University was founded. Starting with scanty funds and two professors, both of whom were teachers of chemistry, the value of the institution brought forth the liberal contributions of JOSEPH E. SHEFFIELD, thereby insuring the future of this work. BENJAMIN SILLIMAN, on his retirement, turned over his work in

geology to the elder DANA, who was his pupil and who married his daughter. His chemistry courses went to his son, BENJAMIN SILLIMAN, JR., who maintained the high standards of his father and added his part in building up a strong department.

It is interesting to note that Professor SILLIMAN as a student in Yale College had no intention of becoming a scientist. Returning to New Haven at the age of 20, he took up the study of law and soon after was made tutor in Yale College. Near the close of his course in law President DWIGHT invited him to become professor of chemistry and natural philosophy, offering him time and assistance for the necessary study and preparation. SILLIMAN then spent two winters in Philadelphia as a pupil of Dr. JAMES WOODHOUSE. There he met PRIESTLEY and was an intimate friend of ROBERT HARE. Returning to New Haven, he took up his duties, his first lecture being on April 4, 1804. In his first class were several men who became famous, one of these being JOHN C. CALHOUN, afterward Vice-President of the United States. After teaching one year, SILLIMAN obtained a leave of absence and spent several months in London and Edinburgh, attending lectures. There he met HENRY, Sir HUMPHRY DAVY and DALTON. It was during his stay in Edinburgh that he became interested in geology, an interest which developed until he became as well known as a geologist as he is as a chemist.

For 15 years Professor SILLIMAN taught and carried out his experiments in a dismal basement room below the old Lyceum on the Yale campus. It is indeed fitting and appropriate that the great Sterling chemistry laboratory, now just completed at a cost of $2,000,000 and containing every facility for teaching and for research, should be dedicated on the anniversary of the first lecture given by the first professor of chemistry in Yale and in honor of a man who was a pioneer in American science.

Steel Production as A Business Index

THE time has not yet passed when business men need to be reminded of the difference between a barometer and a thermometer. The saying "Iron is the barometer of trade" is so old that it says "iron" when the trade designation of the great bulk of the ferrous product now made is "steel." Indeed, partly because the steel ingot, sound throughout, is not yet commonly made, but more generally because much scrap develops in making finished or commercial steel products, the weight of ingots cast, commonly called in the trade "the production of steel," has for 10 years past been running at considerably more than the weight of pig iron produced.

The particular point in the adage really is that steel is a barometer rather than a thermometer—that it foretells. As a thermometer showing the current condition, portland cement, of which we make something like three barrels to a ton of steel, is much better, for steel can be and is stocked by the dealer and consumer, while cement commonly is not. Storage is difficult and is generally by the producer. There are monthly statistics of shipments by cement producers, which are an accurate and prompt index of the volume of construction occurring at the time.

The barometric point about steel is that orders are placed in advance when industrial and construction activity is going to increase. It is the orders, rather than the production, that count as a barometric index. To illustrate, there was a great 3-year period of iron and steel and general industrial activity from late in 1904 to late in 1907. The difference between orders and production was striking. In the fourth quarter of 1904 the U. S. Steel Corporation's unfilled tonnage increased 1,668,767 tons, while in the third quarter of 1907 there was a decrease of 1,178,870 tons. In October, 1907, the month after that quarter and the month of the panic, production of steel made a new high record and was at a rate more than 50 per cent greater than the rate in the fourth quarter of 1904. In 1908 there was an industrial depression. The heavy buying late in 1904 was barometric of the industrial revival then on its way, while the record production of October, 1907, was not even thermometric in showing anything as to business and industrial conditions. The case is strictly typical, not exceptional, and is selected for citation because it was a particularly big case and being before the war may be regarded as normal.

Paradox—The Valley And Its Treasure

IT WOULD BE difficult to cite a topic from the news of the day which would cause the average citizen less concern than the prevailing price of radium. A drop of $30,000 per gram in the price of radium arouses far less jubilation in his breast than would a decrease of $1 per ton in the price of coal. Nevertheless, there is an interesting story back of the recent sensational drop in the price of radium; interesting because, as a result of it, all the radium plants in this country are shut down and because it gives the wiseacres such a beautiful opportunity for whispers of profiteering, cut-throat competition, price-cutting and other shocking practices. What is the real meaning of radium at $70 a milligram?

The answer involves the well-known partners who have been convicted so often of price-fixing—Supply and Demand. It is generally understood that the carnotite deposits of Paradox Valley, Colorado, constitute the largest known source of radium in the world. The average uranium oxide content of this ore is from 1.5 to 2.8 per cent, which means that it contains about 1 milligram of radium per 500 lb. of ore. Obviously, the extraction process is tedious and expensive. Recently there have been shipped to Belgium considerable quantities of very high-grade pitchblende ore from deposits in the extreme southern part of Belgian Congo on the property of the Union Minière du Haut-Katanga, a British-Belgian company operating large copper-bearing properties in Kantanga. An extraction plant has been erected at Oolen, Belgium, to work this ore. Undoubtedly, radium can be produced from this very rich ore at a much lower cost than from carnotite ore. Hence the suspension of extraction operations in this country is the best alternative, particularly since the several companies have been able to consummate working agreements with the Belgian producers for the marketing of their product in this country, thus preserving the identity of their distributing organizations.

In view of the production costs given by H. H. BARKER, on page 1114 of this issue, it is obvious that American radium producers have taken a loss on radium produced from Colorado carnotite and sold at $70 per milligram. Perhaps this was justified by the necessity of turning stocks into available capital, or by the advertising value of a large sale, or both. The

need for working capital in the industry was a consequence of overproduction. The financial depression did not really affect the radium industry until the early part of last year. At that time, when the demand began to slacken, the manufacturers were so unwise as to continue operations too long—a repetition of mistakes previously made in other industries. The result was the largest production in the history of the industry—over 36 grams—a large part of which remained unsold, much of it held by the banks as collateral.

Such are the circumstances that have brought about a reduction in the price of radium to an unprecedented level. Apparently $70 is to be the standard price for domestic and imported material until the Belgian ore gets "leaner" and extraction costs increase. The extent of the African deposits can be determined only by continued working, but it is generally believed by experts that the occurrence of the high-grade ore is limited to a few large pockets that will eventually be exhausted, so that Paradox Valley will come into its own again.

In the meantime, here is an opportunity for philanthropists and public institutions of large means to make radium available for the treatment of cancer and other malignant diseases. The State of New York and the City of Philadelphia have each bought 2 grams for the use of their citizens and the Province of Quebec has bought 1 gram. Surely, the opportunity to make radium and its emanation more readily available to sufferers, rich or poor, should be the most important "meaning" of cheaper radium.

Hunting for Woodchucks And Shooting the Cow

ON VARIOUS OCCASIONS we have commented on the activities of the prohibition enforcement authorities in a vein that has led some of our readers to charge us with failure to give moral support to the law. Perhaps it will be worth while making our position clear.

The Volstead act is the law of the land, and as long as it is, we stand for its impartial enforcement. But the very act which provides for the abolition of alcoholic beverages provides also for the use of alcohol in the industries, and even for its encouragement in this respect. Our protest is against the activities of prohibition enforcement officers that result in the crippling of legitimate industry without practically helping to destroy the drink evil. Failure of the prohibition authorities to perform their duty has become a national disgrace that has rightly caused grave apprehension in the Executive office at Washington. Bootleggers thrive. And simultaneously with the failure to curb these violators of the law, rules and regulations against legitimate industry are multiplied.

A little reflection brings up a related question, and this is whether morally, ethically or even legally the government has the right to introduce poisons into alcohol for the purpose of enforcing prohibition by killing the man who evades the law. This puts the whole principle of attempting to enforce prohibition on a square moral and legal issue, and it leads to the one right and available method of enforcement, which is to catch and punish the offenders.

The separation of denaturants from alcohol, like moonshine distilling, is a forbidden art no matter what the denaturant may be. It *is* moonshine distilling except that denatured alcohol is employed instead of corn or other mash. It is not practiced by law-abiding manufacturers, but it is a great game for the bootleggers. It is a dangerous game, but all illicit business is dangerous.

Changing formulas or the use of vicious poisons will not stop the practice, because there is plenty of money in bootlegging and there are chemists who are willing to conduct research for bootleggers and thus to circumvent any strategem. The question they ask themselves in regard to poisons is not how deadly they may be, but rather how robust they are in their chemical structure. It is mere child's play to try to circumvent the production of beverages by shifts of this kind. Illicit distilling is one occupation, and honest manufacturing is something entirely different. The law recognizes this. Prohibition enforcement officers should, but very often they do not. The chief prohibition enforcement officer lately boasted of the decreased production of tax-paid alcohol, and cited it as evidence of prohibition activity.

We shall not discuss the rum-runners doing business off our coasts with native craft, of which the latter are proper game for the authorities, or the great quantities of alcoholic beverages smuggled in under full authority and warrant from Canada, or the liquors and intoxicants withdrawn or made in secret. They do not come from legitimate makers of varnish, soaps, perfumery, fabrics and the like. Such manufacturers would not sell alcohol denatured or normal for beverages; they are engaged in other business. They do not hide or work in secret and the risk would be too great. The illicit producers and dealers are difficult to find, but it is nevertheless the business of the authorities to find them. The worst method in the world is to make the innocent suffer for the guilty. It is like hunting for woodchucks and shooting the cow.

Poisoning alcohol does not enforce prohibition. And again we ask, Is such denaturation legal or is it not? The man who manufactures or transports alcohol as a beverage or maintains it for drinking purposes commits a misdemeanor. It is not a capital crime. He is entitled to his day in court. Whether he drinks the stuff or not, it would be illegal to shoot him. Then by what right is he poisoned?

A Task for The Chemical Division

ELSEWHERE in these columns we have called attention to the need for adequately supporting the diplomatic and consular services—those governmental agencies that are effective for promoting our foreign trade. In this connection the chemical industry has a problem that is all its own. Much of the information on chemicals that is now being sent in by the government's foreign agents is of a more or less perfunctory character and does not deal with the specific problems or commodities in which the chemical exporter is interested. In order for our industry to profit to the fullest extent from this work it is essential that the consular agents be thoroughly acquainted with the problems of our export trade in chemicals. These men should be properly instructed as to what information is desired, about what commodities and from what particular countries or districts. In other words, there is a need for a consul's chemical manual—a sort of encyclopedia of world competition in chemicals. To prepare such a volume is a task for the Chemical Division of the Department of Commerce and an opportunity for constructive service in developing a healthy foreign trade in American chemicals.

Readers' Views and Comments

European Conditions as I Saw Them

To the Editor of Chemical & Metallurgical Engineering

SIR:—Readers of *Chem. & Met.* who are my personal friends have taken particular interest in the series of articles you have been publishing on "European Conditions as I Saw Them." I have had many conversations with them, and have sought to learn their views on the articles that have already been published. Their opinions are of interest; first, because some of them are somewhat familiar with European conditions, and, second, because of their frankness in passing criticism on my own views.

Permit me to pass in review here some of their criticisms, together with brief answers thereto. Perhaps by so doing, I shall reach other *Chem. & Met.* readers who may have had similar thoughts.

1. The German economic war idea is a *deus ex machina*. I can assure you it is not. In the latter part of March I heard the expression "Wirtschaftlicher Kampf" (economic fight) from a German intellectual, an expression which he used deliberately in the course of conversation on the abnormal discrepancy between the intrinsic and selling values of German finished products. The meaning and the scope of such a war have become clearer and clearer to me the more I have talked about it with intellectuals and average citizens of Germany. This has been reinforced by my observation of German industrial conditions as compared with those in other industrial countries. My conclusion, therefore, that the German economic war was used to create an atmosphere and undercurrent of opposition to the Versailles treaty, and that the cancellation of that treaty and the *status quo ante bellum*, 1914, were offered as a condition of truce, is a normal sequence to the observations made during my trip through Europe.

2. It is not conceivable that German industrials and merchants would be willing to sell at a loss. No, they personally did not lose. Stinnes and his type have constantly grown richer since the Versailles treaty was signed. On the other hand, the masses of the people working for wages and salaries have stood the loss, by getting only a small fraction of what they should receive were they paid the due reward of their labor. A wage of less than 1.5 cents per hour for girls in a German plant, mentioned in my article published Oct. 25, was considered a fair wage in the eyes of many German industrials, just as less than $1 per week for saleswomen in a Berlin shoe store was regarded as a fair wage in the eyes of many German merchants. As to the status of German salaried people, I shall reserve comment for a subsequent article.

3. It is not conceivable that German industrials should thus exploit their own workpeople. I grant that it seems inconceivable, but so was the war. The actual facts prove that it is so.

4. Writers of many sorts—politicians, bankers, economists, amateur students of European conditions, special correspondents and professional interviewers—have written a great deal about conditions in Europe, but none of them has brought forth even a hint as to a German economic war. This is quite true, but I regard it as being due to their individual limitations as observers. Not being in any of the above classes, I observed the industrial conditions closely; and when I looked at Germans at work, I saw clearly what is typified in the cartoon reproduced in our issue for Oct. 18.

5. What has all this to do with European industrial progress? My reason for emphasizing this subject is that it seems to me to be the outstanding cause of much of the distress in Germany, which prevails generally instead of the progress I expected to find. It seems to me a fitting subject to bring into the foreground, in order that American engineers may comprehend the situation and perhaps initiate a policy that will hasten the arrival of the day when everyone will have an opportunity to contribute to industrial progress and receive his fair reward.

6. What comment or reaction do I expect from Germany? It is impossible for me to give a direct answer to this question, but I should not be surprised if *Chem. & Met.* were to receive some protests and objections to various statements that have been made. I feel that I can substantiate with details all general statements that have been made; and, furthermore, I feel that the best refutation that could be given to my statements would be official German statistics of production and export, showing what has become of the products of her industries since the signing of the Versailles treaty.

New York City. J. S. NEGRU.

Wasn't This a Public Service?

To the Editor of Chemical & Metallurgical Engineering

SIR:—At Indianapolis the members of the local section of the American Chemical Society meet at luncheon every week, at the Chamber of Commerce. Usually someone is invited to address them, and whoever speaks may count on courteous and interested attention from an intelligent and scholarly audience. The members come from near enough to Missouri to want to be informed, and if anybody has anything to say or to offer that sounds interesting they are ambitious to know all about it. Then they ask questions.

There has lately been distributed in Indianapolis a little pamphlet, telling the good citizens how whoever will may achieve great wealth by getting it from the air. A remarkable invention is announced whereby "complete union of nitrogen of the air and lignite gas, forming sulphate of ammonia—direct" may be obtained. "The United States," says the circular, "annually imports $32,000,000 of nitrogen in its various forms, and $4,000,000 of sulphate of ammonia, from which is made nitric acid, hydrochloric acid, sodium nitrate (Chilean saltpeter), soda ash, caustic soda and all the ammonias." It declares that a $50,000 investment will enable the investor to reap a profit of $1,400 daily. It provides for "the complete gasification of coal, lignite, peat or shale, the ash being the only residue." Again, "A 1,000-ton plant will give the same results that are secured from a 4,000-bbl. oil well, all without drilling or dry holes." Again, "By the use of the new process . . . it would be possible for a 2,000-ton lignite plant to

recover more than four times as much nitrate as is secured from Muscle Shoals, or, to be exact, 146,000 tons, and the plant would not cost to exceed $2,000,000." In addition, "the new process plant would be capable of producing more electrical energy than Niagara Falls and Muscle Shoals combined." And finally, "This seems to be a sure money-making proposition for any investor," etc.

Who would not grow excited over such revelations as ammonium sulphate from nitrogen and "lignite gas"? Or again, the production from ammonium sulphate of hydrochloric acid, sodium nitrate, soda ash, caustic soda and more particularly *all the ammonias*, not to speak of the wealth that is offered?

So one of the inventors and the chief promoter were invited to join the section at luncheon and to tell all about it, which they did. The members listened politely and attentively, according to their habit. But after the speakers had delivered themselves of a description of all the wonders of their boon to humanity, the questioning period began, and without harsh or unkind words the whole scheme was carefully and logically analyzed. The promoter and inventor got deeper and deeper into contradictions and entanglements, until in the end there wasn't much invention left, and the chance to make squintillions of dollars evaporated right before their eyes.

You've been talking about chemists and public service, Mr. Editor. Wasn't this a public service?

MARTIN SEYT.

British Chemical Industries

FROM OUR BRITISH CORRESPONDENT

LONDON, Nov. 17, 1922.

IN SPITE of the political upheaval, the inevitable disturbance of normal trade due to a Parliamentary general election and a certain amount of depression in the textile trades, the chemical market continues in a fairly healthy state, particularly for heavy chemicals in home markets and also as regards export. Large forward contracts are still few and far between, but now that the "period of tranquillity" policy is to have its chance, competent observers predict a further revival of confidence, and this idea of an improved outlook is reflected by a rise in the quotations for shares in the principal chemical concerns. Acetone is still almost unobtainable and other wood-distillation products are also rising appreciably in price. Croesote is a good market, partly in view of an expected demand from American and British railways.

NEW WEEKLY JOURNAL

In club circles one of the principal topics of conversation has been occasioned by the common knowledge that the Council of the Society of Chemical Industry proposes from the beginning of next year either to publish the society's journal weekly or to discontinue the Review Section; in the latter case the journal would contain only transactions and abstracts and little advertising matter. Certain parts of the present Review Section will be embodied in the new weekly, for which the title *Chemistry and Industry* is suggested. This name was decided upon after some controversy and, perhaps unfortunately, is very similar to the French journal *Chimie et Industrie*. So far, the obvious course of hiring a trained journalist to edit *Chemistry and Industry* has not been adopted and there has been much speculation as to whether a continuation of the policy of amateur technical journalism would not spell failure for a paper which, in the long run, is dependent financially upon circulation and advertisements. The right man has yet to be found, but for the next few months the editorship will be, it is understood, in the hands of Dr. Stephen Miall. It is hoped to arrange for a more extensive circulation and generally to carry out the much-discussed intention of launching a weekly section. The crux of the matter is probably the attitude of advertisers and whether they will stand for the increased rates as compared with fortnightly insertions.

THE PARLIAMENTARY ELECTION

The cry of the trading community at the moment is undoubtedly "more orders," coupled with complaints as to lack of governmental support and understanding. During the war the development of the Department of Overseas Trade on practical lines was a step in the right direction and it is considered very unfortunate that the economy axe should have affected this means of obtaining early information as to opportunities for trade overseas. There is some prospect that the new government will restore the lost activities of this department, which in the past has proved of real use to chemical manufacturers. Chemists in Parliament have been few and far between and Mr. Woolcock, the general manager of the Association of British Chemical Manufacturers, was one of those who did not seek reelection. The results just to hand show that Sir William Pearce, a member of long standing, has been defeated, but C. S. Garland, managing director of Lighting Trades, has been elected, and this will no doubt be as welcome to the many friends he made during his visit to the United States last year as to his colleagues in this country. Dr. G. C. Clayton, a director of the United Alkali Co., succeeded in defeating Mr. Henderson, the well-known labor leader, and there are two or three other manufacturers and directors of technical concerns who will be able to voice the interests of the industry. Max Muspratt, managing director of the United Alkali Co., has just been created a baronet for his past services.

GENERAL NEWS AND NOTES

The Association of British Chemical Manufacturers has just published a new edition of its official directory and classified list of manufactures, which is again printed in six languages, with the notable difference that one of these is now German, to the exclusion of Russian. An amusing feature is the printed list of the officers and council, and it is something of a shock and seems somewhat unnecessary to see Herr Charles Carpenter, Herr E. F. Armstrong, etc., branded with German titles, while in the same list people like Sir William Alexander and Sir John Brunner go scot free. It might have been better to adopt the American habit and give them all the prefix Dr., but needless to say, this does not in any way detract from the usefulness of the publication. The ninth and last volume of the "Technical Records of Explosives Supply" has just been issued by the Ministry of Munitions and deals in a characteristic way with the subject of heat transmission. A memorial tablet to Sir William Ramsay was unveiled at Westminster Abbey last week in the presence of a large and distinguished gathering. Bronze medals struck in honor of this distinguished chemist are now obtainable.

Art and Science of Leather Manufacture—I

First of a Series Outlining the Modern Leather Industry—Kinds and Sources of Hides and Skins — Flaying — Preservation and Cure—Defects—Diseases—Skin Structure and Chemistry

By F. L. Seymour-Jones
Research Scholar, Columbia University

THE tanning industry is unique in that its raw material is a byproduct of agriculture and its finished product is again raw material for the manufacturer of shoes, harness, saddlery, belting, fancy goods and a host of other leather products. No farmer grows an animal for its skin, neither does the value of the skin play any part in the selling price of the animal. Consequently the tanner has as raw material a product variable not only in nature but in the state in which it is turned over to him, according to the care which has been given to it. This position has operated against that standardization which is so characteristic of many branches of American industry. On the one hand, it puts a premium on practical knowledge gained by long experience, a true empirical judgment; on the other, it has resulted in the preservation as trade secrets of processes which the proper application of modern chemical knowledge can often replace cheaply and effectively.

Tanning an Ancient Trade

Tanning cannot yet rightly be classed as a chemical industry. It is one of the most ancient of trades, for the prehistoric hunter certainly learned to dress skins for clothing before he settled down as a planter. But despite early spasmodic efforts at introducing chemistry into the trade—notably by Sir Humphry Davy in 1803—it is only in the last 50 years or so that real progress has been made. Friedrich Knapp, of Germany, in 1858 published his "Die Natur und Wesen der Gerberei und des Leders," dealing with mineral and fat tannages and a theory of tanning. Those interested will find an English translation in the *Journal of the American Leather Chemists' Association*, vol. 16, pp. 158-81 (1921). The late Wilhelm Eitner, in Austria, and Henry Richardson Procter, in England, were the chief among the pioneers in studying tanning processes from a scientific viewpoint. In the last 20 years the number of investigators has multiplied greatly; most countries now have tanning schools and several have research institutes. But there are still many tanneries which do not have a chemist at all. In many others his job is limited to the necessary but uninspiring work of analyzing raw materials (tanning extracts, oils, etc.) and exercising some form of analytical control over the processes.

The reasons for this state of affairs are twofold. Tanners, as a body, are innately conservative, and processes are handed down from father to son for generations, being kept as firm secrets. On the other hand, the problems which beset the leather chemist are among the most recondite of modern science. His raw materials include hides, mixtures of proteins of unknown composition, complicated by their biological origin; vegetable tanning materials, the chemical nature of which is only just beginning to be made clear by the researches of Emil Fischer, Karl Freudenberg and their pupils; mineral tanning agents, notably chromium compounds, perhaps the most unreasonable and complicated of any in inorganic chemistry. The solution to the chemist's problems lies in the application of modern physical and colloidal chemistry, but the chaos existing in the latter subject again hinders progress. In addition he has structural organic chemistry and also enzyme actions to study.

It is only in the last few years that the real fundamentals of the subject are being attacked. The pioneers cleared the ground ably and well, and those suitably qualified are now entering into their inheritance in an almost virgin soil.

There are many definitions both of leather and of tanning. The processes used, or capable of use, are so many and varied that it is impossible to give an entirely satisfactory definition. Broadly, tanning covers the conversion of the readily putrescible hides and skins of animals into a practically imputrescible and durable product known as leather.

The principal raw materials which the tanner has to deal with are hides and skins. The distinction between them is purely one of trade usage, and no hard or fast line can be drawn. The term hide is generally reserved for the larger animals, the ox, cow, heifer, bull, horse, walrus, etc., while the smaller animals provide skins—calf, sheep, goat, pig, seal, etc. Of intermediate size are kips, which strictly speaking are the hides of the small East Indian buffalo.

Sources and Kinds of Hides and Skins

Easily the most important hides are those of the ox or steer. These are obtained not only by local supply in all countries supporting oxen but also by export from cattle-raising countries. The United States ranks high in this respect, and hides from the packing houses have a well-deserved high reputation. Another large source is the Argentine and Uruguay, whence come the *saladeros*. Steer hides, properly flayed, and minus head, horns, etc., range from about 50 lb. to 90 lb. and even more. Their quality depends not only on natural and artificial damages (of which more will be said later) but also on their source. In general cattle from hilly districts furnish better hides than do lowland or plains cattle. Attempts to hasten fattening with oil cake and similar materials tend to produce a more greasy and poorer hide.

The portions of a hide are referred to as bends or butt, bellies, shoulders and cheeks. Except for the first, these terms are self-explanatory. That portion of the hide covering the back and sides of the animal forms the butt, divided into two bends by a line down the backbone. The butt is by far the most valuable portion. The rest is referred to in general as "offal." That side of the hide next the flesh is known as the "flesh," while that of the hair is the "grain."

A steer hide yields a stout, firm butt of close fibrous texture. The bellies are somewhat looser in texture. Younger oxen yield better hides than old ones. Those from beasts used as draught animals are inferior.

Bulls give coarser and more spongy hides, and are usually very thick in the neck and belly, with many wrinkles and folds. Cowhides are flabby, of little elasticity and of poor strength. Heifers yield nice, close-grained hides, which are not as stout or strong as those from the ox.

Horsehides are obtained both from local supply and from South America. They yield a very smooth leather of medium thickness, largely used for boot uppers. Walrus and hippopotamus hides are occasionally tanned, furnishing a very thick leather, chiefly used for burnishing implements and in brake linings.

Kips come from the 1- or 2-year-old cattle of India. They are considerably smaller than oxhides and vary greatly in quality. Prior to 1914 they were exported largely to Great Britain and Germany, either cured or tanned locally. The war, however, caused a great expansion of the Indian tanning industry, and, though it has been badly hit by the slump, a definite permanent advance in tanning more locally is likely to be the result.

Calf and Goat Skins

Calfskins are of variable supply, according to the demand for and the price of veal. In general the bulk is obtained within the country of tannage, and there is no great export and import. They furnish skins of very even, close and fine texture, the female being finer than the male. The finest skins of all are from those animals which have not been weaned. Almost as soon as the calf goes to grass, the extremely fine texture of the milk-fed animal disappears.

In goatskins the United States easily holds pride of place, importing largely from abroad, particularly from India, China, South America, South Africa, the Balkans and the Near East generally. The skin is of a characteristic grain pattern, boldly marked, and is extremely tough and strong. Goatskins furnish the true morocco leather, used for a great variety of purposes. Kidskins are not in great supply. They are of exceedingly fine texture, the same remarks as to sex and feeding applying here as for calfskins. They are dressed largely in France for glove leather, and also come into use for fine grades of shoes. "Glazed kid" is made chiefly from goatskins and is primarily a United States product.

The most important of skins is undoubtedly that of the sheep. Some form of sheep occurs in almost every country throughout the world. But sheep are grown either for mutton (as in New Zealand and the Argentine) or for wool (as in Australia), and it is those countries that are the chief exporters. The quality of the skins varies greatly. Those with fine wool are generally poor, thin and soft. Those grown for mutton are usually fattened with artificial feeding stuffs, and are in consequence exceptionally greasy and fatty. The ideal skin from the tanner's viewpoint is obtained from the mountain sheep; small in size, but of a firm fiber and texture, it yields a very high class of leather. The dewooled skin is technically known as a pelt. The uses of sheepskin are manifold; fancy leathers (including anything from a purse to a vanity bag), bookbinding, slippers, hat linings, cheap shoe uppers, and the imitation of other leathers (morocco, kid and pig).

FIG. 1—REMOVING CATTLE HIDES FROM BELLIES

Lambskins are of an exceedingly fine grain and delicate texture, these qualities rapidly disappearing with growth, especially after the first month. They are used for the finer leathers, notably for glove "kid." Dressed while they still have their short, curly wool, they furnish astrakhan, though this term was originally applied only to slink and pre-natal lamb skins.

Pigskins are of only limited supply, chiefly because in many countries it is customary to sell the skin with the meat, whence it appears on the breakfast table with the bacon as rind. They have a characteristic grain structure, with well-marked hair holes which, in genuine pigskin, also appear on the flesh side. They are used chiefly for saddlery, leggings, bookbinding and bags.

Kangaroo skins, obtained of course from Australia, are of smooth, close texture, and yield a good leather, used much for boot uppers. Sealskins come from the true seal, and not from the fur-bearing animal. They are obtained around Newfoundland, northern Europe and the Cape of Good Hope. The skin is very oily, but yields a very strong leather of compact texture, used for a special type of morocco leather and for japanning or enameling.

Of lesser important skins which come into the market the porpoise, deer, alligator and snake may be mentioned. Shark skin has been introduced in recent years, and other fish skins are sometimes tanned.

Flaying

The process of flaying is outside the tanner's province, but is nevertheless of great importance to him. The old method, still largely used, is with the knife. The danger of cuts, particularly with an unskillful operator, is considerable, and hides may easily be ruined in this manner. It is desirable that no fat should be left adhering to the hide, nor hide tissue to the meat. This requires skill and experience, and even then the best operators use the knife as little as possible, peeling off rather than cutting off the hide. Figs. 1 and 2 give an idea of the methods used by large packing houses.

Many mechanical devices have been suggested, of which two may be mentioned. In one air is pumped in between the skin and the flesh, forcing the skin away from the body, thus rendering its removal an easy matter. In the other the knife is used only for the necessary preliminary slits, the hide being then forced back from the flesh by an automatic hammer.

Of all "take-offs," undoubtedly the best are those from the packing houses in this country and from the large meat plants in South America. Municipal abbatoirs, particularly in large cities, frequently offer premiums for good flaying, which has improved matters somewhat. Hides from private slaughter houses,

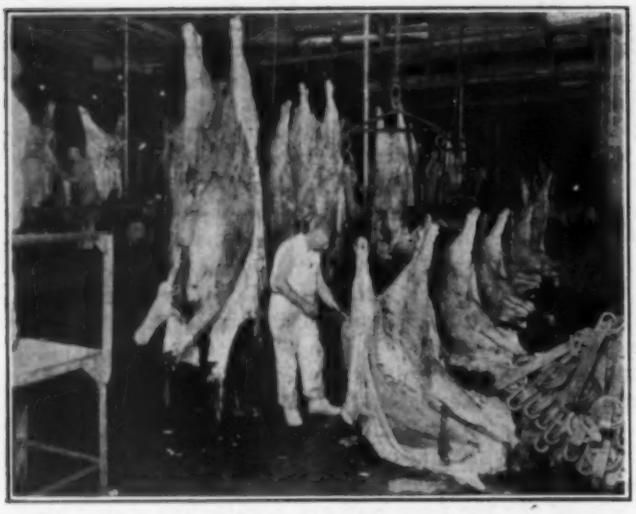

FIG. 2—FLAYING HIND LEGS AND BACKS OF CATTLE

local butchers, etc., are often badly flayed. This was particularly the case with East Indian kips until during the war flayers were accorded extra pay for good work.

Once the hide or skin is flayed it is in a readily putrescible condition. Where a tannery is near enough to a local source of supply, fresh hides may pass into work immediately or at most receive a light salting, as is often the case with small country tanneries in England. Generally, however, preservation is necessary both for imported hides and for those collected in such great quantities at the packing houses. Further, the heavy leather tanner in this country usually keeps a reasonably large stock of raw hides on hand to meet emergencies. Thus, at the up-to-date sole leather tannery of the J. H. Ladew Co., Newark, N. J. (Fig. 3), South American hides are stored as shown in Fig. 4. It will be noted that spaces are left between the piles and that wooden frames are inserted about half way up. Sufficient ventilation is thus assured to prevent heating and decomposition. The temperature at the center of the pile can be determined at any time by simply inserting a thermometer through the space formed by the frame.

SALTING

The usual method for hides is that of salting. The hides are first washed, to remove adhering dung, dirt and blood, and are piled on horses to drain. They are preferably salted in large cool cellars, maintained at a uniform temperature of about 55 deg. F. The hide is spread on a concrete floor, and salt is liberally applied from a shovel by a man, two shovelfuls being sufficient for a hide. The hides are piled in packs, these being made slightly higher at the edges than in the center, so that the brine will penetrate thoroughly. The salting and piling continue until the pack becomes too high for comfortable work. It is then leveled off and covered over with salt. A pack will be from 15 to 20 ft. long and about half as wide (according to the distance between the pillars on the floor). The pack stands about 2 weeks, which is usually sufficient for the cure.

In "taking up," the hides are stripped from the pack and thrown over a horse (a table with an open top) to shake off the surplus salt. They are then thrown flat on the floor for inspection and classification. Finally they are rolled up, with the shanks (legs) and necks inward, the sides folded over, and a neat roll, 15 to 18 in. wide, made, and tied with rope of the size of clothesline. They are then weighed and are ready for shipment. The salt brushed off is swept up and mixed with the next batch for salting. The salt used should be free from iron, as this gives objectionable stains. Consequently raw rock salt is inadvisable.

Another method of curing largely employed, especially in parts of South America, is dry salting. The hides are washed and then hung up in a cool room to permit excess moisture to evaporate. They are next spread on the floor, flesh side up, and the head, shanks and belly folded in. Salt is spread over the hide, and, as the brine cannot run off, the fibers are thoroughly impregnated. A second salting is frequently given, and the hides are hung up to dry to a slightly rubbery consistency. A final coat of salt is applied prior to export. While this method gives economy of shipping weights, such hides are far more difficult to soak back than the ordinary salted, and the crystallization of the salt may have a weakening effect on the fiber.

An analogous method is applied to East Indian kips. The salt used is an earth, found around Cawnpore, Agra, Delhi, Lucknow and Patna, and consists mainly of sodium sulphate with about 20 per cent sand. This is mixed into a thin paste and applied to the flesh side, the hide being permitted to dry over night. A second coat is given, and even a third and fourth to add weight for export, and the hide finally dried out.

Where salt is not available the method used is straight drying. The hides are hung up in the shade or in sheds, in a well-ventilated spot, until dried out. Where the drying is too slow, through stagnant air, the hide will putrefy and "weak grain" will result. Where it is too rapid, as in the sun, the outside will dry, leaving the inside moist; putrefaction sets in, and, on soaking back, the flesh and grain part company, or whole parts of the hide will dissolve, leaving gaping holes. As it is impossible to detect this damage before soaking, and as soaking back of flint dried hides is often difficult, this is the least satisfactory method of cure.

To withstand insect attacks in store or in transit, some preservative is usually applied to the hides. Sodium arsenite is a useful material for this purpose.

Dewooled sheepskins are frequently imported in the pickled condition. Pickling consists in treating the skins in a bath of salt and sulphuric acid, say 8 per cent and ¾ per cent respectively, and then putting them in a concentrated salt solution to bring down the swelling. One bath alone is frequently used, a concentrated brine bath to which a little acid has been added. Hydrochloric acid may be substituted for the sulphuric, and

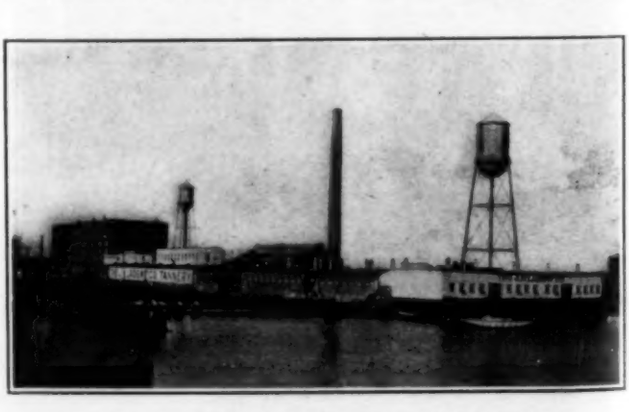

FIG. 3—GENERAL VIEW OF MODERN SOLE LEATHER TANNERY

FIG. 4—HIDE STORAGE

organic acids, acetic and formic, have also been used with good effect. A well-pickled skin will keep indefinitely when kept out of water. In depickling some salt must be added to the water or liquor to prevent the acid exerting an undue swelling action as the salt diffuses out of the skin.

Defects of Hides and Skins

Hides and skins are liable to many defects, in addition to faulty flaying, improper drying and putrefaction, already mentioned. Branding of cattle, while a necessary evil, very greatly lowers the value of a hide. It is usual to keep it to one side of the animal only, so that one bend at least may be free. This evil reaches its height in East Africa, where a special brand is applied at each inoculation against the many tropical diseases, and in India, where the cattle are sometimes deliberately branded all over to prevent those castes which eat meat only from animals which have died (and not been slaughtered) from poisoning cattle for the sake of the meat and hides. Barbed wire scratches are also a common defect in close-farmed countries.

The warble fly is a source of considerable damage to cattle, and to a lesser extent to horse hides. It is only very recently that the life cycle of this fly has been discovered after much painstaking research. The fly lays its eggs on the hairs about the animal's hind quarters. From these the larvæ hatch out and burrow into the skin and along the body to the gullet, finally reaching the back, passing through various forms en route. Just beneath the skin the larva bores an air hole, through which it finally emerges on hatching. The loss through these holes to the tanner, and through "blown beef" to the slaughterer, is immense. A kip in the museum of the Leeds University (England) leather department has about 680 warble holes in it, and similar cases are well known to tanners. The British Ministry of Agriculture has a commission studying the question of prevention and cure at present. A final report is expected shortly. The most promising methods are squeezing out the grub by hand (laborious and impossible of general application) and the application of a nicotine-lime wash. By these means it is possible to exterminate the fly in a district in 5 or 6 years, provided the method be thoroughly carried out.

Salt stains arising from the cure are a frequent source of damage to hides. They arise from a variety of causes, chromogenic bacteria, bacterial action through insufficient salting, iron from the salt or from the blood, or from impurities in the salt, where, as on the continent of Europe, denaturants have to be used for commercial salt. The use of a pure salt, or, for a denaturant, of sufficient alkali (5 per cent sodium carbonate) to prevent the development of bacteria, is the best means of avoiding this source of damage.

Sheepskins are liable to many natural ills, of which two are most important to the tanner. Cockle consists of a disturbance of the pelt structure resembling a hard pimple of well-defined appearance, which becomes a deep brownish black in the tan liquors. It appears early in the year, but disappears immediately after shearing. It is largely caused by the intensive fattening of sheep with artificial foodstuffs (oil cake and the like), very common in England. Colt, or dead fat, is another trouble, probably due to the degeneration of the fat cells of the skin, leading to hydrolysis of the fat and crystallization of the fatty acids in the skin. It also is connected with artificial feeding.

The only definite occupational disease of the leather industry is anthrax, arising from infected hides in transit and in soaking. It is particularly prevalent in hides from the East. Various means have been suggested for disinfection, but unfortunately most disinfectants have a tanning action (e.g., formaldehyde, phenols, cresols, etc.) and it is difficult to obtain an efficient one which will not damage the hide. While it is easy to destroy the anthrax bacillus, the spore is highly resistant. A treatment in 1 per cent formic acid and 1 part in 5,000 of mercuric chloride, followed by a brine bath to complete the "wet-salting," has been tested with encouraging results. The use of mustard oil has also been suggested.

Skin Structure

The skins of all mammals have the same general structure, hence a description of one broadly covers all, allowing for particular variations. Some knowledge of this structure is essential for the proper understanding of the working of skins, especially for "splits"—i.e., where the hide or skin has been split horizontally. The skin consists of two principal layers, the epidermis, and the corium or dermis. They are of very different properties and even origin. The fertilized animal ovum rapidly separates into three layers, from the outer of which the epidermis is derived; the corium, together with bones and muscle, develops from the middle layer.

The epidermis is comparatively thin and is removed by the tanner in depilation. It consists of a lower, mucous layer, of living cells, and an upper layer, formed of dead cells, which are gradually worn away. The transition from one layer to the other is not abrupt, but really a series of successive stages of decay. To the epidermis also belong the hairs, sebaceous and sudoriferous glands; though these are deeply imbedded in the corium, they are surrounded by a thin epidermal sheath. The sebaceous glands resemble a bunch of grapes, and serve to lubricate the hair. They are squeezed by the *erector pili* muscle, running from the hair root sheath to the epidermis. This muscle is an involuntary one, and is the cause of "gooseflesh" and of making the hair stand on end. The sudoriferous or sweat glands are connected with the epidermal surface by a spiral duct. Other epidermal structures include horns, nails, claws, etc.

The corium is that major part of the skin which is made into leather. It is composed in the main of a densely interwoven mass of white fibers. Close to the grain surface, and to a lesser degree on the flesh, yel-

low elastic fibers also occur. These serve to bind and support the white fiber bundles, and to draw the skin back to its original shape when stretched. Toward the flesh side groups of fat cells are to be found, and the whole is nourished with fine blood capillaries. The upper layer of the corium is the grain membrane, very thin, and bounded on top by the hyaline surface, which, if damaged, will result in uneven coloring. Below the grain membrane lies the compact fiber-bundle layer of the *pars papillaris*, so called from the projecting papillæ which form the characteristic grain pattern of the skin. Below this layer are the more open-fibered sebaceous and adipose layers (*pars reticularis*), in which the sebaceous glands and hair roots are imbedded, together with fat cells. The corium is connected to the body by a network of connective tissue (*panniculus adiposus*), frequently filled with fat cells. Many animals also possess a thin voluntary muscle (*panniculus carnosus*) just beneath the corium, used for twitching the skin to drive off flies, etc.

Chemical Nature of the Skin

The skin regarded chemically is a very complex body, built up mainly of proteins. Such mineral salts as occur are mainly phosphates and calcium compounds, in addition to those arising from the blood. The proteins belong to the unclassified group—i.e., scleroproteins. The epidermis consists mainly of keratins, the "old keratin" of the outer layer being more resistant to acids and enzymes than the "young keratin" lying next the corium. Keratins are insoluble in water, but are easily hydrolyzed by alkali and sodium sulphide solutions, a property used in unhairing. They are characterized by a comparatively high sulphur content.

The white fibers composing the bulk of the corium are formed of collagen, the parent substance of gelatin. Indeed, it is generally regarded as an anhydride of gelatin. It is insoluble in cold water, but is hydrolyzed in hot water to form gelatin. It swells readily in acids and alkalis, and is eventually hydrolyzed thereby. It is readily dissolved by pepsin, and less readily so by trypsin, unless previously reduced to a powdery state. Freed from keratins and elastin, by liming and bating, the collagen of the hide when ground up forms hide powder used in tanning analysis and experimental work. Far more work has been done on gelatin than collagen; the fibrous structure and insolubility of the latter render it less suitable for experimental work, and results obtained with gelatin usually closely parallel those with collagen. The collagen is the leather-forming substance of the skin, and its combination with tannins, chrome salts, etc., forms leather.

The elastin of the elastic fibers is the most resistant of all the hide proteins to reagents. It is, however, readily hydrolyzed by trypsin, and this property is used in bating. Mucins occur in the cementing substance joining the white collagen fibers together; they appear to be a degradation product of the fibers themselves. The grain membrane is of unknown composition; it is not collagenous, since it does not yield gelatin on boiling. Very little is known of the skin fats, though they appear to be mainly lecithins and cholesterols.

Acknowledgment

Illustrations for this article were made available through the courtesy of Armour & Co. (Figs. 1 and 2), and the J. H. Ladew Co. (Figs. 3 and 4).

(This article will be followed by others on this subject, to be printed in subsequent issues.)

What Is the Meaning of Radium at $70 per Milligram?

Is It "Cutthroat" Competition, Overproduction or Attempt to Put Industry on Stable, Co-operative Basis?

By H. H. Barker

THE public was somewhat surprised when it was announced, a few months ago, by one of the leading producers of radium that the price had been reduced from around $120 to $90 per milligram, but quite astounded when a further reduction to $70 was announced a few weeks ago by still another of the large producers. Who will be next to knock off another $20 to $30? Surprise at this matter is not amazing when we consider that for the past 5 to 10 years there has been an attempt to educate the public to the belief that radium was cheap at the current prices, and that the price must eventually rise. However, there are still those (perhaps they are not apace with the times) who still believe that the time is not far distant when radium will cost twice the sum of $70 per milligram.

In connection with this matter a few facts and some figures may be of interest. Anyone familiar with the radium-bearing ore deposits of the United States is cognizant of the fact that practically all of the ore comes from one section of the country which could be surrounded by a circle 200 miles in radius, and that the condition of mining, quality of ore, etc., are about the same throughout this region except for a few undeveloped deposits of virgin ore. It might therefore be assumed that no one concern has the "drop" on the others when it comes to obtaining the virgin ore at a ridiculously cheap figure.

Production Costs

It has been estimated by quite reliable authorities, who are familiar with the type of mining involved in the production of radium ore, that even under the most favorable conditions for mining a fair group of claims, the cost to produce a ton of 2 per cent uranium ore, containing 5.3 mg. of radium element, will be at least $150. To say the least, this figure is conservative and allows for only a small proportion of development work. As pointed out by George Kunkle,[1] as time goes on and the readily available ore is used up, more and more money will have to be expended in exploration work, with the result that the cost of ore will rise. Mr. Kunkle conservatively estimates the cost of radium in ore delivered to the railroad at $28 per milligram under present conditions.

The cost of processing a ton of ore is somewhat problematical and difficult to estimate unless put on a tonnage basis, where a certain quantity of ore is treated per month, 12 months of the year. However, it is probably safe to estimate that the cost may range from $100 to $150 per ton, depending upon the quantity of ore treated, overhead expense, methods used, cost of chemicals, labor, etc. The cost of recovering the uranium and vanadium is not taken into account here.

Taking the average of the figures given for the cost of processing, plus the cost of the virgin ore, we find that we have invested in the radium recoverable from 1 ton of 2 per cent uranium ore a total of $275. In the event that a recovery of 85 per cent is obtained (which

[1] *Eng. Mining J.-Press*, vol. 114, No. 12, p. 503, Sept. 16, 1922.

is undoubtedly higher than any company now producing can boast of over its entire period of production), the cost per milligram will be approximately $61, while on the basis of 80 per cent recovery the cost will be approximately $65. Add to this the cost of selling, plus the cost of maintaining the service which certain companies have established, and the total cost is easily $75 per milligram.

The average merchant feels that he is entitled to from 20 to 50 per cent profit on the commodities which all of us must of necessity buy. Certainly a radium manufacturer is entitled to a profit comparable to this, and it is questionable whether his margin should not be much greater when we consider what a risky undertaking the production of radium is and what opportunities for losses are involved. However, let us assume that the manufacturer is entitled to a profit of one-third the cost of production. On this basis the minimum price which radium should sell for is $100 per milligram.

In other words, it would seem that concerns which are selling radium produced from American ores at a price much under $100 are losing money and will ultimately face a deficit. A fact that further substantiates the statement that there is no profiteering in radium at $100 is that only one of the large producing concerns has ever paid any dividends, and in its case it is also a well-known fact that its radium has netted it well above $100 per milligram. What industry is able to go on indefinitely without paying dividends? Sooner or later those who have been doing their financing will become impatient and discouraged, unless they realize some returns in the way of real money.

Possible Significance of Cheap Radium

There appear to be four possible solutions to account for $70 radium, which will be briefly presented:

1. This reduction in price may be a means of discouraging competitors and in some instances putting the smaller fellow out of business. It might also serve to discourage new capital which may be contemplating entering the industry. Provided the position of some of our American manufacturers is so strong financially that they can afford to do this, it may be very effective, but it is a question whether they will not impair their own financial condition before they do that of some of their competitors. The fellow who is viewing the situation from the spectators' bench has nothing to lose but his time.

2. This reduction in price may be a bargain sale on radium, used as a means of raising real money on a large inventory of finished product. In the long run this would seem to be rather poor business, as it upsets the market, which, in the handling of a commodity such as this, is apt to slow up buying and create certain obstacles which may be difficult to surmount when the readjustment time comes. Then too, these firms are sacrificing their product at a price below cost of production, and eventually will have neither radium nor money.

3. This reduction in price may be the result of prospective importation of radium. From good authority, it has been ascertained that there was received in Belgium a few months ago 60 tons of 50 per cent uranium ore, from which 6 to 7 grams of radium can be obtained. The extent of the deposits in the Belgian Congo from which this ore was obtained is unknown, but it is quite improbable to conceive of their having a mountain of such ore. It might be well in this connection to call attention to the fact that several tons of very high-grade ore (perhaps not 50 per cent) have been taken from pockets on some American claims, but it did not follow that the entire region was permeated with such ore or even the entire claim from which the high-grade ore was obtained. It is logical to assume that one of these high-grade pockets was struck in the Belgian Congo deposit and that the ore has been pretty well removed. It is possible, of course, that there may be a tonnage of fair ore available, and again there may not be any appreciable quantity of ore of a commercial grade. What the total production of such a find will amount to time only can determine.

4. Have recent advances in X-ray therapy made some producers of radium fear for the stability of their industry? On this point the writer has no definite data, but he feels that this factor has had no material influence in the present slump in the price of radium.

Effect of Slump on Industry

However, let us assume that the 60 tons has been processed and the radium is ready for marketing. It is easy to realize that the cost per milligram will be nominal on such a grade of ore, and a handsome profit can be realized selling for $70 even allowing a $20 commission. It is quite possible that some of our American organizations have the agency for this material and are thus able to put radium on the market at this low figure.[1] Such a price for radium, in small quantities, is not only demoralizing to the other producing concerns but it is also demoralizing to the customer. He immediately assumes an attitude of suspicion, for, as stated before, he has been educated to expect an increase in price, and, contrary to his expectation, comes a decline. It is considered good business never to buy on a declining market, and presumably many persons will look at this situation in such a manner. Equally true, it is considered good business to buy on a rising market provided you get in shortly after the price starts to mount. Perhaps we are just preparing for a rise in price by getting right down to rock bottom as a basis.

When all is said and done, we must come to the conclusion that even in the event that the market for radium is somewhat demoralized at present on account of imported material, we shall eventually have to get back to the consumption of our own product, and with such consumption an advance in price is inevitable.

What is to be the outcome of all this "cutthroat" work in the marketing of radium? Undoubtedly, the survival of the strong—and possibly the fit—who are able to weather the storm and after the "fly-by-night" concerns have passed by will have a legitimate industry whereby they may realize a fair return on their money invested. When such time comes we shall undoubtedly see more co-operation among the producers than there has been in the past, and we shall not have such large variations in the price of radium as quoted on a recent order of fair size. The prices quoted ranged from $77 to $120 per milligram. Some such a co-operative agreement would undoubtedly prove to be of benefit to the large as well as the small producer, and can be most efficient in helping to establish the future of radium both in the professions and as an industry.

Columbia, Mo.

[1] Editor's Note. It has recently been announced by the Radium Company of Colorado that since July last members of the executive and technical staffs of the Radium Company of Colorado have been in Belgium working out details of the new radium enterprise, and that the Radium Company of Colorado, with main offices in Denver, which is to market the Belgian product in America, has formed a joint corporation with the Société Générale du Radium to market radium throughout the world.

A Method for Determining The Rate of Sulphation Of Storage Battery Plates

By G. W. Vinal and L. M. Ritchie
Bureau of Standards, Washington, D. C.

Experiments Which Have Been Made to Develop a Speedy and Accurate Method for Measuring the Effect of Impurities in Storage Battery Electrolyte—The Fundamental Theory of the Method, and Measurements of the Rate of Sulphation of the Lead Plates in Pure Solutions

THIS investigation was undertaken to establish if possible a speedy and accurate method for the measurement of the effect of impurities in storage battery electrolytes. Preliminary experiments in which small cells were "poisoned" by the addition of the substances to be studied showed that accurate and consistent results were difficult to obtain. The capacity of the negative plates is ordinarily greater than that of the positives and the effect of such impurities as affect the negative plate is therefore masked, in part at least, when determinations of the capacity are made. It is difficult also to insulate the small cells so perfectly that leakage current during the periods of standing will not affect the measured capacity. It is often necessary to permit several weeks to elapse in order to determine the loss in capacity resulting from the impurities which are added. Because of the inaccuracies of this method and the time required, it was decided to determine the effect of the impurities in terms of the rate of the reactions taking place at the plates. This may be accurately determined in a short time by successive weighings of the plates immersed in solutions which are maintained at a constant temperature.

In the present paper it is desired to present only the fundamental theory of the method and the results which have been obtained for the rate of sulphation of positive and negative plates in solutions of pure sulphuric acid of various concentrations. According to Dolezalek[1] measurements of the rate of self-discharge of the plates in varying concentrations of the electrolytes have not been made. The method here described affords a simple and accurate means of obtaining this information. The changes taking place at the negative plate are most readily studied by this method, but the interpretation of the results obtained on positive plates presents greater difficulties. The method is not immediately applicable to the study of such impurities as serve as oxygen carriers between the plates of different polarity. In a subsequent paper the effects of impurities will be discussed.

Arrangement of the Apparatus

The general arrangement of the apparatus is shown in Fig. 1. Twenty-four plates were suspended by glass hooks and entirely immersed in the electrolytes, which were contained in six rectangular glass jars, four plates to each jar. These jars were carried on a revolving frame in the thermostat bath which permitted the plates in any jar to be brought to a point directly underneath the left-hand arm of the balance. The balance was mounted on a marble slab over the thermostat tank as shown in the illustration. By this arrangement it was possible to weigh each plate while immersed and without exposing it to the air. The thermostat tank was filled with water to within 1 in. of the top of the jars. The temperature of the water could be controlled by a thermo-regulator at any desired point within the range 20 to 40 deg. C. The variation of the temperature of the water from a fixed point was within 0.01 deg. The water was stirred continuously. Each jar was provided with a wood cover impregnated with paraffine.

The plates selected for the experiments were those made for starting and lighting batteries by two manufacturers. Small sizes of plates were selected to avoid overloading the balance, which was of high quality having a nominal capacity of 200 grams. The plates of maker A were $5\frac{3}{8}$x$4\frac{1}{8}$x$\frac{3}{16}$ in., those of maker B were approximately $5\frac{3}{8}$x$4\frac{3}{8}$x$\frac{3}{16}$ in.

To adapt plates to the conditions of our experiments, the lug was cut off and burned on again in the middle of the top edge in order to balance the plate when suspended in the liquid. Two holes were drilled in the lug. One of these was used for the glass hook which suspended the plate from the balance during weighings and the other for a second glass hook which supported the plates when weighings were not in progress.

Experimental Results

Weighings of the plates were made daily and the results computed as the increase of weight per hour. Three sets of weighings extending over a period of 48

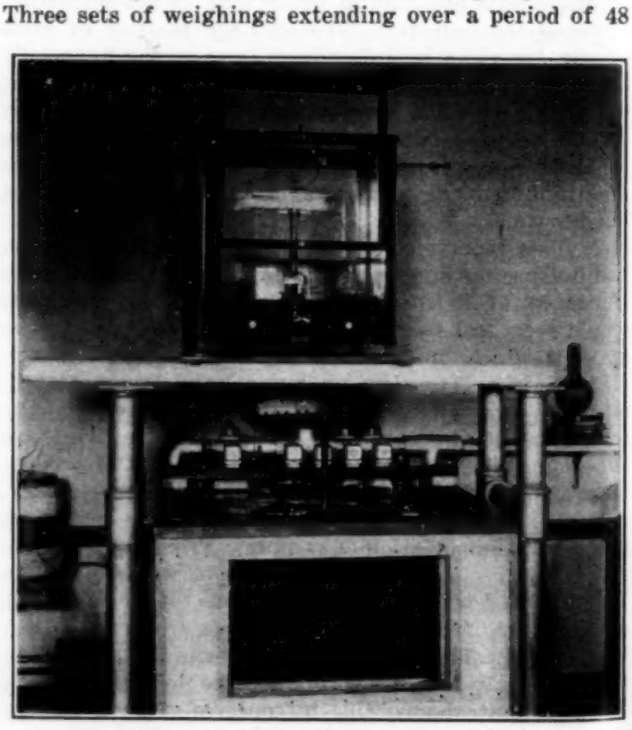

FIG. 1—APPARATUS FOR DETERMINING RATE OF SULPHATION OF STORAGE BATTERY PLATES

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[1] "Theory of the Lead Accumulator," p. 139.

hours were sufficient to give two determinations of the rate of change in weight of the plates. These two determinations in nearly all cases were in good agreement. Four weighings at 25 deg. C. were made, giving three determinations of the change in weight. The mean of these is given in the table below. Since the weighings were made in the electrolyte, a buoyancy correction was necessary. This correction has been calculated on the assumption that the materials have the following densities:

Lead	11.3
Lead sulphate	6.3
Lead peroxide A plates	8.7
Lead peroxide B plates	8.8

Since the values for the density of lead peroxide found in the literature differ widely, determinations of the density of the active materials of the positive plates in the fully charged condition have been made by Mr. Peffer at the Bureau of Standards with the results given above. Analysis of the active materials by Mr. Altrup shows 97 per cent lead peroxide in the positives of each manufacturer, 97 per cent lead in the negatives of manufacturer A, and 91.5 per cent lead in the negatives of manufacturer B. The expanders in the negatives were carbon in each case. The buoyancy corrections are applied to a small difference of two weighings, and hence a slight error in the density of either the solutions or the active materials produces a negligible error in the final result.

The densities of the solutions were determined directly by the use of calibrated hydrometers.

The chemical reactions during discharge at the plates are generally assumed to be:

$$Pb + SO_4 = PbSO_4 \quad \text{Negative plate}$$
$$PbO_2 + H_2 + H_2SO_4 = PbSO_4 + 2H_2O \quad \text{Positive plate}$$

Since the molecular weight of lead is 207.20 and of lead sulphate 303.26, the gain in weight during the transformation of 1 mol of lead to lead sulphate is 96.06 grams and the relative gain in weight (96.06 ÷ 207.20) times the weight of lead acted upon. There is of course a large amount of lead which does not take part in the reaction and decreases the sensibility of the weighings, but in spite of this fact and the heavy damping resulting from the viscosity of the electrolytes the balance was sufficiently sensitive to permit an accuracy of a few tenths of a milligram to be obtained.

From the rate of change in weight of the plates the equivalent loss in ampere-hour capacity can be computed. The valence is 2 and hence a gain in weight of the negative plate of 96.06 grams is equivalent to 2 × 96,500 coulombs. From this the change in weight is computed to be 1.79 grams per ampere-hour.

Both chemical and electrochemical reactions are possible at the negative plate, but the former are probably predominant over the latter during self-discharge. This is indicated by the results for the A plates in 1.150 and and 1.400 acid. The gain in weight per hour in the stronger acid is twenty-three times that in the more dilute. The change in potential of a lead plate as the concentration of the electrolyte is changed from 1.150 to 1.400 sp.gr. is less than 0.1 volt, according to the measurements of Gladstone and Hibbert.[3]

The resistivity of the more concentrated electrolyte is higher than for the 1.150 sp.gr. electrolyte. On the basis of Ohm's law, therefore, this marked increase in the extent of the reaction cannot be readily accounted for as an electrochemical reaction.

[3] *J. Inst. Elec. Eng.* (British), vol. 21, p. 430 (1892).

TABLE I—GAIN IN WEIGHT, GRAMS PER HOUR, OF NEGATIVE PLATES IN SOLUTIONS AT 25 DEG. C., SATURATED AND UNSATURATED WITH LEAD SULPHATE.

Sp. Gr. $\frac{25°\text{ C.}}{25°\text{ C.}}$	Gain in Weight for Plates of Manufacturer A, Sat. Sol.	Manufacturer A, Unsat. Sol.	Manufacturer B, Sat. Sol.	Manufacturer B, Unsat. Sol.
1.150	0.0022	0.0031	0.0048	0.0058
1.200	0.0026	0.0071	0.0118	0.0120
1.250	0.0036	0.0098	0.0178	0.0290
1.300	0.0060	0.0115	0.0283	0.0394
1.350	0.0151	0.0270	0.0385	0.0558
1.400	0.0460	0.0480	0.0906	0.0960

The measurements on the negative plates at 25 deg. C. are given in Table I. Each figure is the mean of six observations (three measurements on each of two plates). Buoyancy corrections have been made.

These results show that the rate of sulphation is decreased appreciably in the saturated solutions of concentrations corresponding to those ordinarily used in storage batteries. The solutions were saturated with chemically pure lead sulphate when hot and were permitted to cool before the plates were immersed. The electrolyte in a lead storage battery is ordinarily saturated with lead sulphate, although the electrolyte is initially a solution of pure sulphuric acid. In the unsaturated experiments the ratio of the mass of acid to the mass of the plates was so large that saturation could not occur in as short a time as is ordinarily the case. Each jar contained 4.5 liters of solution and four negative plates.

The question has been asked, Why it is injurious to permit a discharged cell with low gravity of electrolyte to stand when the results of this paper show that the rate of sulphation is less in the solutions of low gravities? The answer is that the low gravity of electrolyte in the discharged cell is merely incidental and the state of charge of the plates is the controlling factor. The plates for these experiments were initially fully charged.

The rate of sulphation decreased as time progressed. This is especially noticeable in the case of the plates of manufacturer B in the unsaturated solutions of higher concentration, as is shown in Table II.

TABLE II—DECREASE IN RATE OF SULPHATION WITH TIME, NEGATIVE PLATES IN UNSATURATED SOLUTION.
(Measurements on Plates of Manufacturer B.)

Date	Gain in Weight, Grams Per Hour, for Each of Six Concentrations 1.150	1.200	1.250	1.300	1.350	1.400
Feb. 19	0.0059	0.0132	0.0304	0.0416	0.0574	0.0976
Feb. 20	0.0053	0.0110	0.0289	0.0414	0.0560	0.0964
Feb. 21	0.0061	0.0121	0.0275	0.0352	0.0535	0.0942
Feb. 22	0.0050	0.0118	0.0260	0.0369	0.0484	0.0818
Feb. 25	0.0052	0.0110	0.0247	0.0359	0.0498	0.0819
Feb. 27	0.0053	0.0113	0.0236	0.0332	0.0470	0.0769

It can easily be computed that the capacity of the plates would be exhausted in a relatively short time if the initial rate of sulphation were to continue indefinitely. The decrease in the rate of sulphation is probably to be attributed to the protection which the lead sulphate affords to the underlying active material and also the increasing amount of lead sulphate present in the solutions which were initially unsaturated. The effect of the presence of lead sulphate in decreasing the rate of sulphation of the plates has been shown in Table I, but the effect of saturating the solution in holding the rate of sulphation constant for a few days during which measurements of the effect of impurities can be made is of fundamental importance in establishing the validity of this method. This is made clear in Table III, in which comparative results for the plates of manufac-

turer A are given for a period of 3 days for both the saturated and unsaturated solutions. The results with the minus signs express the decrease in rate of sulphation during this time. Inconsistent results are to be observed for the solutions of 1.150 and 1.200 sp.gr., but this is not surprising, since these solutions are in the region of the minimum solubility for lead sulphate according to the curve given by Dolezalek.[3] In this region there can be but little distinction drawn between saturated and unsaturated solutions. The measurements made on the plates of manufacturer B were not as consistent as those for manufacturer A because of a tendency for the active material to scale off, which produced an error in the results.

TABLE III—EFFECT OF SATURATING THE ELECTROLYTE WITH LEAD SULPHATE ON THE CONSTANCY OF THE RATE OF SULPHATION OVER A PERIOD OF 3 DAYS

(The minus signs indicate a decrease in the rate and plus signs an increase. Plates of manufacturer A)

	Change in the Rate of Sulphation, Grams Per Hour, in Solution at 25 Deg. C.					
Solution	1.150	1.200	1.250	1.300	1.350	1.400
Unsaturated....	+0.0017	+0.0013	—0.0031	—0.0045	—0.0029	—0.0037
Saturated.....	0.0000	+0.0005	0.0000	0.0000	—0.0009	—0.0014

The effect of temperature on the rate of sulphation is important. In Table IV are given the measurements made on the negative plates of both manufacturers when the solutions were maintained at constant temperatures of 22, 25 and 30 deg. C. The increase in the rate of sulphation from 22 to 25 deg. is proportionately greater than from 25 to 30 deg.

TABLE IV—EFFECT OF TEMPERATURE ON THE RATE OF SULPHATION OF NEGATIVE PLATES

Sp.Gr. $\frac{25°\text{ C.}}{25°\text{ C.}}$	Gain in Weight, Grams per Hour, Saturated Solutions for Plates of					
	— Manufacturer B —			— Manufacturer A —		
	22°	25°	30°	22°	25°	30°
1.150.....	0.0031	0.0048	0.0056	0.0012	0.0022	0.0022
1.200.....	0.0073	0.0118	0.0118	0.0016	0.0026	0.0027
1.250.....	0.0111	0.0178	0.0196	0.0028	0.0036	0.0051
1.300.....	0.0183	0.0283	0.0325	0.0046	0.0060	0.0082
1.350.....	0.0270	0.385	0.0420	0.0122	0.0151	0.0198
1.400.....	0.0614	0.0906	0.1027	0.0350	0.0460	0.0544

Local action at the positive plate is essentially electrochemical, resulting from the difference in potential between the oxide and the lead-antimony alloy of the grid. Metallic impurities are not precipitated by the oxide, and Dolezalek and Finckh[4] have stated that no solubility of the peroxide in solutions of the specific gravities ordinarily used in storage batteries can be detected. The reaction at the positive plate in these experiments is therefore to be regarded as the general expression for the discharge of a cell, with the qualification that the negative electrode may be lead or lead-antimony alloy depending on the construction of the plate.

$$PbO_2 + Pb + 2H_2SO_4 = 2PbSO_4 + 2H_2O$$

The lead sulphate formed appears on both the peroxide and the grid.

The gain in weight of the positive plates is not as simply related to the total amount of sulphate formed as in the case of the negatives. The sulphate which forms on the grid or the underlying lead is equal to 96.06 grams for 2 × 96,500 coulombs, but the change in weight of the positive plates because of the formation of sulphate on the peroxide is 64.06 grams for the same quantity of electricity. The difference is accounted for by the formation of 2 mols of water at the peroxide.

[3] "Theory of the Lead Accumulator," p. 145.
[4] *Z. anorg. Chem.*, vol. 51, p. 320 (1906).

TABLE V—GAIN IN WEIGHT, GRAMS PER HOUR, OF POSITIVE PLATES IN SOLUTIONS AT 25 DEG. C. SATURATED AND UNSATURATED WITH LEAD SULPHATE

Sp.Gr. $\frac{25°\text{ C.}}{25°\text{ C.}}$	Plates of Manufacturer A		Plates of Manufacturer B	
	Saturated Solution	Unsaturated Solution	Saturated Solution	Unsaturated Solution
1.150.....	0.0128	0.0111	0.0077	0.0138
1.200.....	0.0121	0.0096	0.0077	0.0090
1.250.....	0.0069	0.0060	0.0047	0.0051
1.300.....	0.0053	0.0022	0.0050	0.0061
1.350.....	0.0050	0.0019	0.0048	0.0062
1.400.....	0.0047	0.0031	0.0049	0.0088

This means that 160.12 grams of sulphate would be formed on the positive plate if the quantity of electricity flowing were 2 × 96,500 coulombs. The ampere-hour equivalent for the gain in weight resulting from local action, is, therefore, 2.99 grams for each ampere-hour. The experimental results for the positive plates in solutions of varying concentration at 25 deg. C. are given in Table V for solutions saturated and unsaturated with lead sulphate.

It will be observed from the results given in Table V that the gain in weight of the positive plates decreases as the concentration of the solution increases. This suggests that the plates contained some soluble constituent, the solubility of which increased as the concentration increased, but the data which are available on the solubility of lead peroxide and lead oxide fail to offer an explanation. In the solutions which were saturated the gain in weight of the plates was more for manufacturer A but less for manufacturer B than in the unsaturated solutions. The difference in behavior may be attributed to the different methods used in preparing the paste for these plates, but no exact explanation can be given now.

Petroleum Laboratory List Being Compiled

The Bureau of Mines is revising its list of commercial laboratories to which correspondents are referred when they wish to have chemical analyses made. This is necessary because the policy of the Bureau of Mines does not permit making analyses for private individuals unless such analytical work forms a part of a larger project which is being carried out by the bureau in the public interest. Due to an unforeseen delay the formal questionnaires which were to be sent out in connection with the revision of this list have been held up. They are now being forwarded to the various laboratories, however, and a prompt response is hoped for. Laboratories which are not on the present list are invited to communicate with the Bureau of Mines relative to their ability to carry out the various tests on petroleum products. The bureau reserves the right to limit the list to laboratories that appear to be qualified to do the work.

Gummy Substances in Gasoline

A study of various methods of evaporation and oxidation of cracked gasolines made by the Bureau of Mines leads to the conclusion that gummy and resinous deposits are caused by oxidation and have no direct relation to unsaturation as determined by solubility in sulphuric acid. In the investigation made by the bureau a new and convenient method was developed for determining "gum" in gasoline. The study of gums and their formation leads to the conclusion that they are polymerized aldehydes, which probably are formed by the oxidation of olefins, etc. Storage tests confirm the above conclusions. Details of the investigation made by the Bureau of Mines are given in Serial 2394, "Gum-Forming Constituents in Gasoline," just issued.

The Protective Action of Copper in Case Carburizing

BY JAMES C. MCCULLOUGH (Associate Professor) AND H. A. HOLDEN PRAY
Severance Laboratory of Oberlin College, Oberlin, Ohio

ONE of the common methods of preventing action on certain parts of a piece of steel that is being carburized by the cementation process is to cover these parts with a plating of copper. Even though this is common practice, it fails at times in a way that is not understood. Illustrating this, we quote a few sentences from a discussion following a paper on "Case Carburizing" by C. G. McFarland, as published in the *Transactions* of the American Society for Steel Treating, vol. 1, page 305:

Mr. Stenger: "I would like to ask if you can give us an explanation of just why copper plating prevents carburization."

Mr. McFarland: "I cannot."

Chairman: "Maybe somebody here would like to ask the question why it does not at times."

The literature records some work along this line by Giolitti, Habec, Guillet and Bernard, Zimmerli, and others and is contradictory to a degree. We have been studying the matter at some length, and in this communication, which is in the nature of a progress report, we give the ideas we have so far acquired. If any readers have had experiences which bear upon the problem we should very much appreciate hearing from them.

GOOD PLATES EASILY MADE ON GOOD STEEL

Of course our first assumption was that the commonly accepted theory of carburization is correct and that CO gas is the active carburizing agent. It also seemed probable from published data that CO does not diffuse through copper to any appreciable degree even at 950 or 1,000 deg. C. We assumed that this failure of the copper protection in certain cases was due to holes in the plating and we tried to prove this assumption.

None of our copper platings on clean, uniform steel failed to protect unless we scratched through the copper. In some cases the copper seemed to diffuse over the scratches or file marks and the sample emerged from the furnace without any sign of carburization. This seems to have been noted by others but not explained. We do not attempt to explain it.

Since all of our first platings from a cyanide bath gave adequate protection, we began to look for some that would not protect even when considerable care was used in plating. A low-carbon steel with slag and ghost lines gave this erratic behavior, and we consequently confined our attention to it in an effort to show at least one reason why copper fails to protect.

IMPERFECT RESULTS ON LOW-GRADE METAL

The latter material was of low carbon content and in the form of round rods or pieces cut from steel bar ½ in. thick and 2 in. wide. These pieces were cleaned in hydrochloric acid containing 1 per cent by volume of 40 per cent formaldehyde solution (Holmes patent) and then plated over part of their length in a copper cyanide bath of the following composition: water 10 qt., sodium carbonate crystals 8.5 oz., sodium hydrogen sulphite crystals 7 oz., copper carbonate 7 oz., and potassium cyanide (98 per cent) 8.5 oz. The pieces were then carburized by packing in a sheet-iron box 3x4x6 in., the mixture being 3 parts wood charcoal and 2 parts barium carbonate. The temperature, measured at the center of the box, was held at 1,000 deg. C. for 75 minutes and then permitted to drop with the electric furnace.

Cross-sections of these rods were then examined under the microscope to determine the degree of carburization and the condition of the copper plating. Great care was necessary to prepare these sections without damage to the copper. The method finally chosen was to mount the sample in a type metal composed of lead 8 parts, antimony 2 parts and tin 1 part. Standard pipe caps for ¼-in. gas pipe make convenient cups for this mounting. A harder alloy than type metal would be desirable, but they have higher melting points and dissolve part of the copper. There was a marked tendency for the copper to tear loose from the iron and be carried out into the alloy during the grinding of the sample and even the edge of the iron seemed to flatten out into the type metal mounting. Successful grinding was obtained only by coating the carborundum papers with paraffine, avoiding much pressure during polishing and holding the sample in one position during the entire process instead of changing direction with each change of paper. By this method the one edge of the iron rod where the direction of motion was from type metal to iron could be successfully examined. A new grinding was necessary for each edge examined.

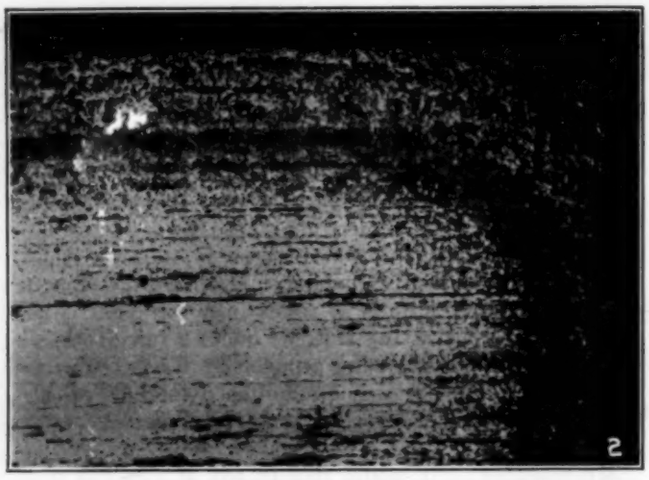
Microscopic examination of such samples was very satisfactory even with the highest power oil-immersion lens, the red color of the copper being very apparent. Photomicrographs were also prepared (some of which are reproduced), but with considerable difficulty. The type metal always ground away to a lower level than the iron and copper, making a sloping junction that was very hard to adjust for clear focusing over much of the field at one time. Photographs were all made on Wratten M plates using Wratten light filters. With the blue (C) filter copper shows in the print as black, while with the red (A) filter the copper prints white and may be distinguished from slag or structure lines in the steel.

COPPER 0.004 MM. THICK PROTECTS IRON

Without exception the samples examined showed no carburization under copper plating, except when there were holes in the copper. Carburization was always in proportion to the number of such holes.

Copper plates perfectly from a cyanide bath on to clean, pure iron or steel providing a low current density is used. We got complete protection with a plating of 0.004 mm. thick deposited at a current density of 0.08 amp. per square decimeter, while a plating 0.006 mm. thick deposited at the rate of 0.6 amp. afforded very little protection and showed many holes. Copper will not deposit on spots of slag or oxide that come to the surface of the iron. Breaks in the copper and consequent carburization always seemed to accompany such structural marks in the steel unless the copper deposit was made very thick.

Figs. 1 and 2 show the conditions at corners at opposite ends of the same sample of low-grade steel bar. One end had been copperplated, the other was bare and clean. After carburization, the clean end (Fig. 2) was seen to be carburized about the same depth inward from the sides and from the ends. This indicates that penetration was no deeper one way than the other, even though the slag lines might have afforded open channels for the gas. We do not believe that CO followed these slag lines to any marked degree, but we are sure that



FIGS. 1 AND 2—CORNERS ON OPPOSITE ENDS OF SAME BAR.
ETCHED WITH 5 PER CENT HNO_3, 95 PER CENT ALCOHOL
Fig. 1—Copper plated end. × 50. Fig. 2—Bare end. × 25.

these slag lines cause holes in the copper plate through which the gas does enter and diffuse into the steel in all directions. This is plainly shown in Fig. 1.

Fig. 1 has a copper plate 0.004 mm. thick (too thin to show at this magnification). Owing to the difficulties in polishing and photographing, the edge of the sample is marked by a black streak, beyond which appear the large crystals of the white-metal mounting. The plating across the "fiber" was quite defective, while it was much more perfect around the sides. Consequently gas penetration was from the ends only. Much of the pearlite in the carburized zones has been divorced, and fairly large masses of carbide may be seen. This occurrence is to be expected in such impure steel, as shown by McQuaid and Ehn in several recent papers.[1] This structure, and breaks in the copper plate, are shown more clearly at higher magnification in Fig. 3. It shows the edge, normal to slag lines, of the same piece of steel photographed in Fig. 1.

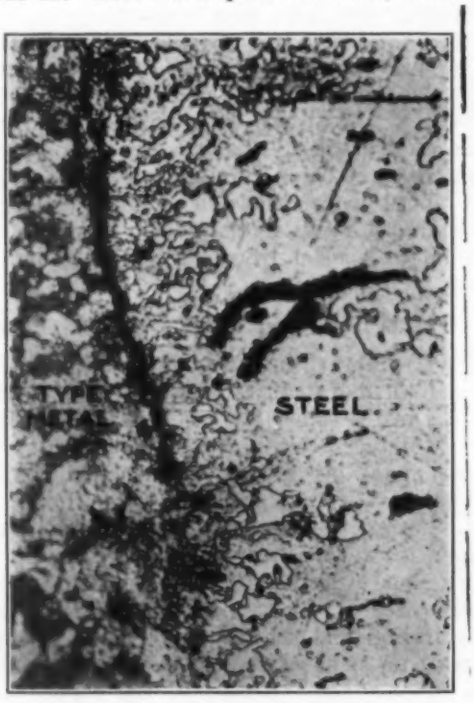


FIG. 3—SAME AS FIG. 1. × 500
Etched with 5 per cent HNO_3, 95 per cent alcohol. Blue filter. A portion of the edge normal to slag lines shows breaks in copper plate and divorced cementite beneath.

[1]American Institute of Mining and Metallurgical Engineers, N. Y. meeting, February, 1922. British Iron and Steel Institute, May, 1922, meeting. American Society for Steel Treating, Detroit meeting, October, 1922.

Conclusion

Our work strongly supports the following view of the theory of case carburizing and its prevention by plating with copper. It shows the cause of failure in at least some cases and points to a reliable remedy. When soft iron is heated in a charcoal pack, the carbon monoxide gas penetrates into the iron and gives up some of its carbon to the iron to effect the desired carburization. Carbon monoxide gas does not dissolve easily in copper and hence cannot pass through it unless there are cracks or holes in the copper. A thin copper plating over iron should, therefore, prevent carburization unless there are flaws in the copper. We found such flaws in every plating examined that had failed to prevent carburization and we found no breaks in the effective platings.

Treatment of Oil Field Emulsions

D. B. Dow, chemical engineer of the petroleum experiment station of the Bureau of Mines at Bartlesville, Okla., who is making a study of oil field emulsions, recently interviewed a number of operators at Tulsa, Okla., and obtained information on methods of dehydration that are being used by different companies. It was found that most companies are using chemicals for treating oil field emulsions, although in a number of fields the centrifugal process is in rather general use. An extended series of laboratory tests has been made to determine the effects of large amounts of water when produced with the oil. It was found that with 10 per cent oil and 90 per cent water, only a small percentage of B.S. was formed and that about 98 per cent of the water separates on standing. By decreasing the amount of water and increasing the amount of oil, the percentage of B.S. increases and the amount of free water decreases. The laboratory experiments coincide with the information that has been obtained from field men to the effect that in a well producing excessive amounts of water there is less trouble from emulsions than in one that produces a comparatively small amount of water. Additional laboratory tests will be made to determine the effect of finely divided material on the formation of oil field emulsions.

The Donnan Program of Investigation for the Chilean Nitrate Industry

The Present Method of Caliche Treatment Is Outlined and a Critical Examination Is Made of a Recent Suggestion That the Operation of the Shanks Process Should Be the Object of Intensive Scientific Research

BY A. W. ALLEN
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BETWEEN December, 1918, and July, 1919, Dr. F. G. Donnan made an extensive investigation on methods of treatment in vogue and results being obtained at a number of nitrate oficinas[1] in Chile. The ultimate sequel to the visit was the publication of an elaborate report,[2] issued by the Chilean Nitrate Committee in London.

Dr. Donnan, who is professor of general chemistry at the University College of the University of London, is well known as one of the leading authorities on many important phases of chemistry. His researches, apart from a brilliance that places him among the front rank of present-day scientists, indicate an originality above the normal. His writings are usually constructive and helpful. He has been an outstanding figure among those who are attempting to solve the many problems connected with colloidity and adsorption; in 1910 he propounded what is now known as the Donnan theory of membrane equilibria, support and elaboration of which is to be found in Dr. Jacques Loeb's recently published monograph on "Proteins and the Theory of Colloidal Behavior."

Dr. Donnan writes fearlessly of conditions on the pampa. The most striking fact revealed by the inspection was the "great dearth of exact quantitative data" and the absence of results of "detailed scientific investigations. The time has come," it is averred, "when these defects must be remedied as rapidly as possible." Investigation work is recommended as the panacea, the report under review being concerned mainly with its organization, direction and control.

In a preliminary section the distinguished chemist deals with the general economic conditions affecting the Chilean industry, discusses the possible competition of synthetic products and emphasizes the fact that "no great industry can progress without keeping a vigilant watch on the progress and development of its competitors." Discussing process control, Dr. Donnan draws attention to the deplorable conditions observable on the pampa. Like many others who have gone before, he found that "no proper means of determining the essential data existed, and such as were determined and reported were often either erroneous or falsified."

CAUSES BEHIND DEPLORABLE CONDITIONS EXISTING ON THE PAMPA

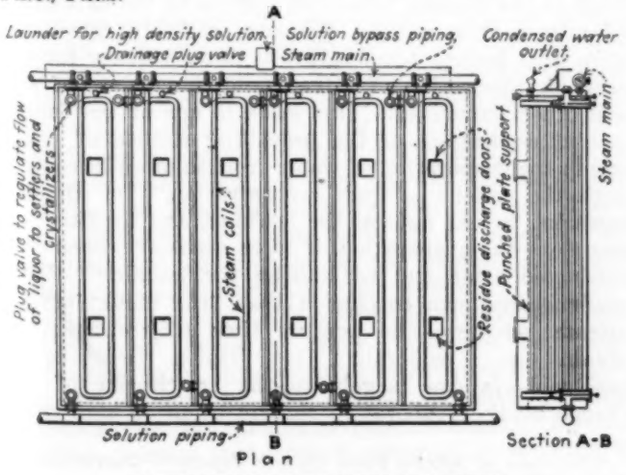
Among the causes of the present state of affairs are mentioned (1) inadequate technical staffs; (2) want of close technical control of the processes of manufacture; (3) the tendency to be satisfied with present profits, regardless of the technical inefficiency of the processes and the wasting of material; (4) the control of the industry by men of business, men unpossessed of any chemical or engineering knowledge. "A clean cut must be made with the methods of the past . . . The highest possible premium must be placed on accuracy and moral and intellectual honesty . . . Only really well-trained men must be appointed—men who have already demonstrated their capacity for technical and scientific investigation."

Verily a "clean cut" will be needed to separate the industry from those who have hitherto had control of technical operations—who have derided the efforts of independent engineers to obtain recognition of fundamental principles—who have systematically discredited scientific fact by the contention that all that could be tried has been tried, "back in the '70s or thereabout"—who discourage initiative by camouflaging the results of inefficient operation so that they appear presentable—who are helping to squander Chile's resources by a determination to ignore the wastage caused by the selective mining of the highest grade of caliche. Dr. Donnan's suggestions as to the need for "moral and intellectual honesty" are especially applicable. If the "clean cut" proposed be made it will mean the elimination of much that is reprehensible in the operation of the industry.

The technical side of Dr. Donnan's report is confined almost entirely to a consideration of the results—actual, possible or problematical—of continuing the present method of operation known as the Shanks process. He maintains that "we must thoroughly control and understand the existing process before we attempt to improve it." The personnel of the proposed research department

[1] GLOSSARY: **Agua feble**—solution obtained by refrigeration of **agua vieja**, which is the mother liquor remaining after the fractional crystallization of high-density nitrate solution to atmospheric temperature; **batea**—crystallization vat; **borra**—sludge found underneath punched-plate support in vat, also in solution and clarifying tanks, also used (incorrectly) to refer to slime in caliche; **cachucho**—boiling tank in Shanks plant; **caldillo**—any liquor with more nitrate than mother liquor and less than **caldo**, which is of the highest density and temperature; **caliche**—nitrate-bearing material containing, in addition to nitrates, soluble impurities in a number of forms and in varying proportions; **chullador**—an open, flat-bottomed vat used to settle the slime and salt in the solution before crystallization; **cancha**—place where nitrate is dried and sacked; **costra**—material of low nitrate content usually found near caliche; **crinolina**—perforated-plate false bottom in treatment vat on which charge of caliche rests; **maquina**—nitrate plant; **oficina**—nitrate property equipped with plant; **relave**—weak nitrate liquor; **ripio**—residue, usually only referring to that portion that comes from above the punched-plate support in the treatment vat; **salitre**—commercial nitrate.

[2] "Report on a Program of Investigation for the Chilean Nitrate Industry," by Prof. F. G. Donnan, C.B.E., M.A., Ph.D., D.Sc., F.I.C., F.R.S.



CACHUCHOS IN SHANKS MAQUINA

is to consist of four research chemists, one research physicist, one geologist, one mineralogist, four analytical chemists, one mechanical engineer, one chemical engineer, one mining and metallurgical engineer, two draughtsmen, et al. The technical staff will be chosen, other than in exceptional cases, from among those who have attained "the D.Sc. or Ph.D. standard of the best European and American universities." An ambitious program of work is proposed, involving heavy expense. The candidates should preferably be between 25 and 35, and an "adequate pension scheme" is recommended. The task of finding out what is wrong with the Shanks process is to be tackled in no hasty, commercial spirit.

So little has been published about the Shanks process that it will not be out of place to preface my comments on Dr. Donnan's conclusions by a brief description of its fundamental features. The caliche (nitrate-bearing material), after hand sorting, is reduced in swing-jaw rock breakers to about 3 in. The wearing plates of these abrade at a maximum in the center; and many or few large lumps, according to the condition of the plates, escape proper reduction. The crushed material then goes by conveyor or gable car to the vats, which are rectangular and of iron, six generally forming a nest; each is equipped with steam coils. A perforated-plate support with ⅜-in. holes is fixed a few inches above the bottom of the vat. The caliche is tipped into the upper section and usually segregates into coarse and fine, the steam pipes, acting as a grizzly, aiding the classification that occurs. An even distribution of the material in the vats is looked upon as entirely unnecessary. Large dividends have been paid for years by companies whose technical staffs have followed the original plan.

Operation of the Shanks Process

The arrangement of piping to, from and around a typical cachucho (boiling tank) is shown in the accompanying line drawing. Provision is made for the passage of solution from vat to vat; but as all of these are on the same level, no upward or downward percolation is possible. For the most part the solution passes from underneath the perforated-plate support into the side of the adjoining vat. Enrichment of the solution is achieved by submerging the caliche with liquor from a nearby charge, followed by boiling or high-temperature maintenance. During this phase of operations the liquor becomes thoroughly contaminated with slime; when a high density is reached it is laundered to a settler, where dung or flour is added to assist sedimentation. The clear liquor is then decanted and sent to crystallizing vats, the slimy dregs from the settler going to waste. Owing to the ease with which the nitrate content of the solution can be augmented by evaporative concentration in the cachuchos there is no difficulty in obtaining a high-grade crystal after ordinary cooling to atmospheric temperature. Broadly speaking, the industry is confronted with no problem of a chemical nature directly connected with the manufacture of a high-grade nitrate product from caliche.

After an imperfect displacement treatment in the cachucho, the material is finally washed with water and discharged. The mud that collects underneath the crinolina, or punched-plate support, shares the same fate as that which is discharged from the clarifying vats: it is treated as waste.

Such are the essentials of the Shanks treatment. Various modifications have been proposed or put into practice. Fine grinding has been attempted; but the boiling or high-temperature maintenance in the vat involved the freeing of too much slime. In some oficinas the sludge from below the perforated plates has been removed from a discharging vat and placed on top of one undergoing treatment, with results not difficult to imagine. At some plants an attempt has been made to treat this mud by decantation or filtration, but unsuccessfully. In a few cases the fine constituents of the dry charge have been isolated and treated separately, but the scanty data available have shown that the problem has been only partly solved.

Large Losses on the Pampa Due to Neglect of Fundamental Principles

I do not find myself in agreement with Dr. Donnan's general program. The Shanks process, he admits, has been a miserable failure, as judged by present-day requirements. "We may assume," he says, "that 40 per cent of the nitrate contained in the material arriving at the works is at present lost." This confirms my own opinion that, "although optimistic figures have been given at various oficinas as to the amount of nitrate extracted, it is improbable that the actual recovery in crystal form and ready for shipment exceeded, on the average, 55 per cent of the nitrate originally in the caliche; and it is certain that in very many cases the amount was considerably below this estimate."[3]

Scientific workers are paid little enough, but there is another type of investigator who often gets nothing for his labor. I refer to the person who thinks several times before he acts. A little analytical and constructive thought on the problems of the pampa will do more to bring prosperity back to the industry than will the expenditure of vast sums of money to determine the precise physicochemical happenings in a Shanks maquina. The failure to improve results has been due to a neglect to appreciate the fundamentals of any process employed for the removal of a soluble salt from an insoluble gangue. The technical men in control of the industry apparently refuse to realize the importance of simple and fundamental facts.

Inefficient Extraction in Shanks Process

Dr. Donnan remarks that "Providence has so arranged that in the cycle of the Shanks maquina the unwanted constituents are usually purged with the final boil of the caldo" (liquor of highest density and temperature). But Providence is equally kind to those who have no faith in the Shanks scheme as applied to the extraction of nitrate from caliche, for any solubility curve will show that boiling temperature is not necessary for the selective absorption of nitrate and the release of salt and other impurities. This leads to one of the fundamental weaknesses of the prevailing method of treatment: the evaporation of water from solution in contact with the caliche. "Such concentration," Dr. Donnan remarks, "works against the leaching, and for this reason alone the evaporation, if it be necessary, should be conducted after and not during the leaching." This confirms my own conclusion that "the inefficiency of nitrate recovery—the lengthy time of treatment to obtain even moderately low ripios [leaching-vat residues]—is due largely to the enrichment of the charge by the evaporative concentration of high-grade

[3] "Recovery of Nitrate From Chilean Caliche." Charles Griffin & Co., Ltd., London.

solution and by the addition of caldillo [weak nitrate liquor] and aqua vieja [mother liquor]. These high-grade nitrate solutions have low dissolving powers. Caldo is formed mainly by evaporative concentration, and not by the abstraction of nitrate from the caliche; and this involves the augmenting of the nitrate in the cachucho, resulting in a proportionately high ripio. The boiling or high-temperature maintenance disturbs the equilibrium of the charge, causing the borra [sludge] to circulate with the solution and finally to find its way underneath the crinolina and thence to the surface of other charges or to the relave [weak nitrate liquor] tanks.'"[4]

The Borra Bogey an Illegitimate Excuse for Poor Yield

In reading Dr. Donnan's report one is constantly reminded of the fact that he has been duly impressed by the borra bogey. When the rotos, or workmen, of the Chilean pampa become fractious at the high cost of beans and carry their grievances to Santiago, the government counters their complaints with a scare: "Peru is about to attack us." "Viva Chile!" they all shout, and prepare to defend their beloved country with the last drop of their Araucanian blood. And the price of beans is forgotten. Similarly, on the Chilean pampa, an inquiry as to the reason for the pitiable results usually obtained by the Shanks process invariably elicits a tale of woe about borra. This bogey should be laid reverently to rest, for it has worked hard and long to deflect attention from one of the principal causes of technical failure in the nitrate industry. A thousand and one ideas have been proffered to solve the problem of what to do with the layer of sludge found underneath the crinolina and deposited during clarification in the chulladores (settling vats) and in the relave tanks. Dr. Donnan has an elaborate program prepared for his research department. An amazing fact again emerges: that investigators fail to realize that the process ceases to be leaching as soon as a portion of a charge is removed with the percolating liquor. The effluent is no longer a solution, and the material left in the vat does not represent the residue. Further, the abstraction of slime from the vat connotes channeling; the equilibrium of the charge is disturbed, making regular percolation impossible.

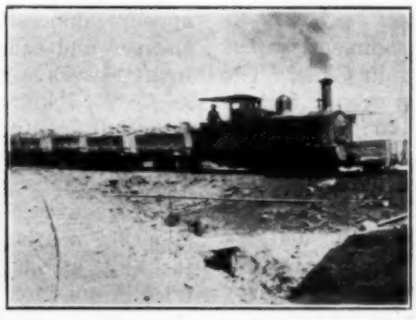
Assuming that other conditions are correct, the deposition of borra, or slime, from the leach liquors resulting from downward percolation is due to inadequate support for the charge. If the pioneers in cyanidation had practiced bulk treatment of comparatively coarse, dry-crushed material by leaching in a vat with a "filter" bottom of ⅜-in. holes, failure would have resulted in the same way as it has on the pampa. A proportion of the slime would have washed through, channeling would have resulted and extraction would have been poor.

The borra bogey has served to obscure an important fundamental fact—that physical considerations must be given primary attention. The first thing is to see that the process is working as such. If it be leaching, then percolation must be even; the effluent solution must be free from insoluble. Physical conditions must be arranged so that this is possible; consideration can then be paid to the question of efficient extraction. In Chile little or no attention has been given to physical considerations. Much finer grinding of the caliche has been suggested as a logical departure, in order that a charge may consist of particles of a size permitting even percolation, even dissolution of the nitrate and even drainage; but operators have pooh-poohed the suggestion, because, forsooth, more borra would be formed or released! Thus it is seen that the bogey crops up at every stage; it is used at every opportunity to frighten the interested visitor.

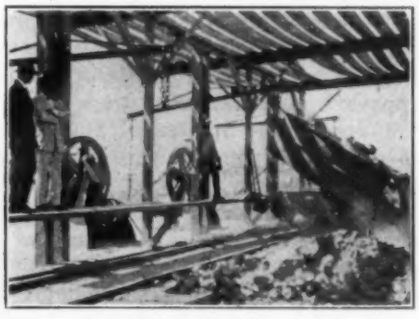
The borra in Chilean caliche of average composition is easily and inexpensively treated, provided (1) it is held in position throughout all stages of submergence, leaching and drainage; and (2) that adequate support is provided for the charge, permitting regular percolation and low moisture content in residue. Fineness of grinding must be such that there is no appreciable movement of borra in the direction of the percolating solution. Muddy liquors in Shanks-maquina operations are caused "(*a*) by the disturbance of the equilibrium of the charge by boiling or high-temperature maintenance in the cachuchos, and the freeing of an unnecessary amount of borra; (*b*) by uneven resistance to flow of solution through the charge, resulting in short circuiting; and (*c*) by the incomplete and unsatisfactory support for the charge by means of punched plates, leading to local collapse at numerous small areas and the washing through of borra and sand."[5] No investigation should be started until agreement is reached that muddy solutions are incompatible with correct physical conditions for leaching. Dr. Donnan, after summarizing the action in the chullador, says that "clarification presents a number of problems . . . very careful and scientific attention must be paid to these operations." A better, cheaper and safer plan would be to consider the production of solutions free from borra.

"If boiling and evaporation are to be prevented in the boiling tanks," suggests Dr. Donnan, "probably the best way to do this would be to close the tops and

SORTING CALICHE ON THE PAMPA



BRINGING CALICHE FROM THE PAMPA



MECHANICAL CAR TIPPING AT A PLANT

[4] Ibid., p. 6.

[5] Ibid., p. 10.

preheat the liquor between each leach." The removal of the steam coils and the avoidance of the external heating of solutions between vats was put in practice on an operating scale over 2 years ago. No investigation is necessary on the part of the proposed research department to determine the practicability of the step. As to closing the tops of the vats, I do not understand what is meant, although I have suggested[6] the use of float insulators on the surface of the solution to prevent heat losses from radiation.

Donnan Fails to Mention the Possibility of the Use of Grainers in Crystallization

Under the subject of crystallization, Dr. Donnan touches lightly on batea practice, dwelling primarily on the time factor. The heat loss during crystallization cannot be considered important, but I think that emphasis might well be laid on the fact that, because of large areas needed, the cooling of solution en route to the more distant bateas is inevitable. "Most of the heat available for evaporation is dissipated by conduction losses and direct contact with excess cold air. When the solution has reached such a temperature that evaporation is slight, the deposit of crystals on the sides and bottom of the batea prevents or delays the chilling of the liquor to low temperatures. Excessively large installations are needed to counteract the inefficiency of operations at every stage of the process."[7]

I was disappointed not to see some comment by Dr. Donnan on the possible use of grainers in Chile. The apparent advantages of their adoption would include "(1) reduction in area of plant required; (2) ability to grade product, from high-grade crystals containing caldo (with low salt percentage) as moisture, to the ordinary commercial nitrate; (3) elimination of all hand labor and the continuous and automatic delivery of crystals of varying grades, from pure nitrate to a commercial product; (4) avoidance of launder delivery of caldo for long distances, with reduction of radiation losses, prevention of formation of small crystals and high moisture percentage in product; (5) ability to control heat losses during the earlier stage of cooling, so as to obtain maximum evaporation of water; and ability to hasten the later stage when evaporation is slight."[8]

The Donnan Report Also Omits the Large Economy of Atmospheric Evaporation

The extended use of vacuum-pan evaporators in the nitrate industry is desirable and logical; but to my mind a serious omission from the recommendations for research is in connection with what is usually referred to as solar evaporation. I am still of the opinion that "Primary consideration must be paid to the possibility of utilizing the extraordinarily favorable atmospheric conditions prevailing at all seasons of the year on the Chilean nitrate pampa—the heating effect of the sun, the abnormal dryness of the atmosphere, the persistence of high winds and the almost entire absence of rainfall. These advantages indicate conditions that are highly favorable to solar evaporation. The feasibility of utilizing the evaporative powers of the air in conjunction of the sun-heating of thin layers of liquor at a negligible expense offers advantages that cannot well be disregarded. The problem confronting the industry as soon as the present high-grade deposits are nearing exhaustion will be in connection with the recovery of a commercial nitrate from a comparatively low-grade brine. The fractional crystallization of such a solution by solar evaporation and the production of an impure crystal must inevitably be an important phase of any scheme suggested."[9]

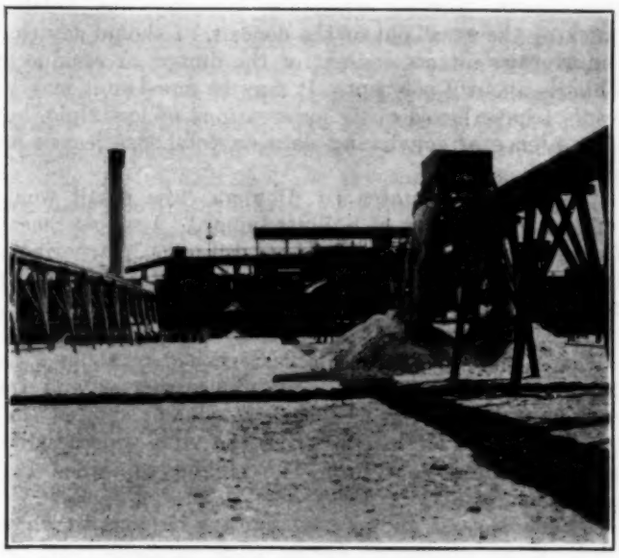
I carried out in Chile, on three separate occasions, tests on the evaporation of water from aqua vieja by natural means. At the time I had access to an unusually complete series of weather reports on another pampa, from which I judged that the favorable conditions I observed were not merely local. The evaporation amounted on an average to 9 liters of water per square meter of surface exposed per 24 hours. One test indicated that the evaporation amounted to 146 in. per annum. In another test it was found that the exposure of 1 sq.m. of aqua vieja resulted in the deposition of a heavy crop of crystals containing 89 per cent nitrate ($NaNO_3$). Other experiments proved that a considerable amount of commercial nitrate is obtainable from aqua vieja by this method, provided the evaporated water is replaced at the same time by more aqua vieja. At a certain stage, however, an impure crystal is deposited, after or just before which the brine might be returned to the treatment plant.

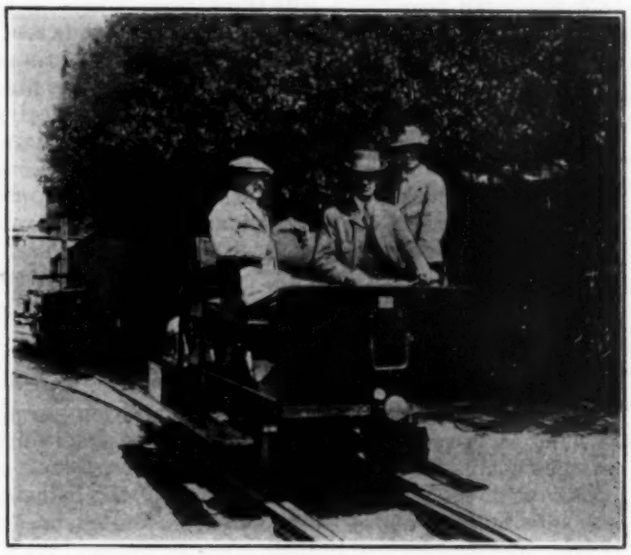
If the caliche is of high enough grade, and so long as an expensive method of evaporation is feasible, it appears impossible to interest pampa operators in a cheaper and equally effective alternative. Other saline industries have gone through the same experience; but, so far as I know, the technical men of the pampa and their advisors represent the only group determined to ignore the possibilities of natural evaporation. In Utah, an important brine deposit was a commercial failure when quadruple-effect evaporators were used; but by adoption of solar evaporation it was transformed into a technical as well as a commercial success. In the district in question the rainfall is about 3 in. per annum, the net evaporation being 36 in. In many parts of the Chilean pampa there is no rain, and the evaporation amounts to over 100 in. per annum.

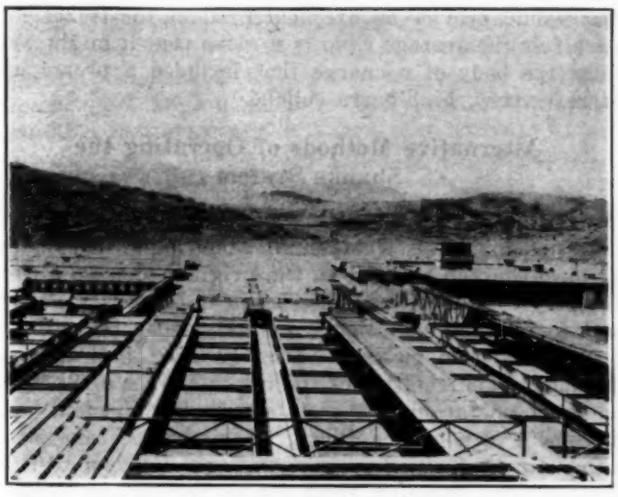
Questionable Value of Separate Treatment of Fine Material

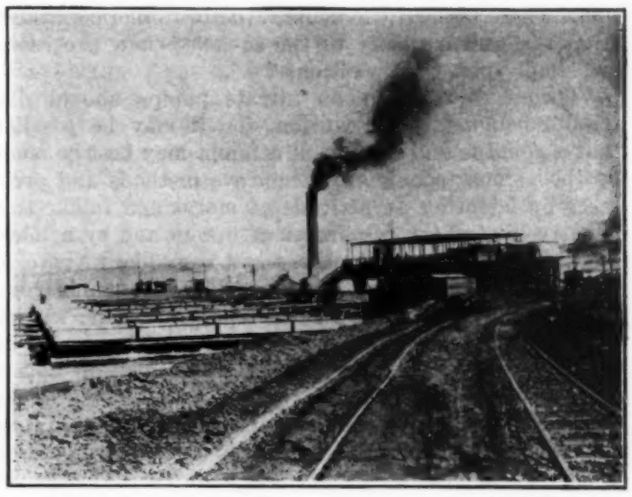
Considerable investigation is proposed to determine the advisability for the separate treatment of fine material subsequent to its isolation from the caliche. Expecting a gradual diminution in grade of caliche treated, I see no prospect for the ultimate adoption of any of the schemes proposed. If the removal of fines from ordinary caliche gives improved results, it is obvious to me that the methods in vogue for the extraction of soluble are at fault; for, in leaching, much of the fine material is needed to maintain the texture of the charge, to insure even percolation and to prevent channeling around the larger lumps. Segregation of fines involves heavy expense and waste of nitrate, or it necessitates the application of pressure or vacuum filtration. Paul F. Holstein, whose experience in this connection in Chile has been unusually complete, stated recently: "The past 10 years has seen much, on the whole, unprofitable experimentation with new processes, most of them attempts to apply bits of knowledge snatched from milling practice without any great understanding of the applicability of the methods. The use of filters of various types is an example of one of these unfortunate efforts. While the nitrate man has gained costly knowledge, his

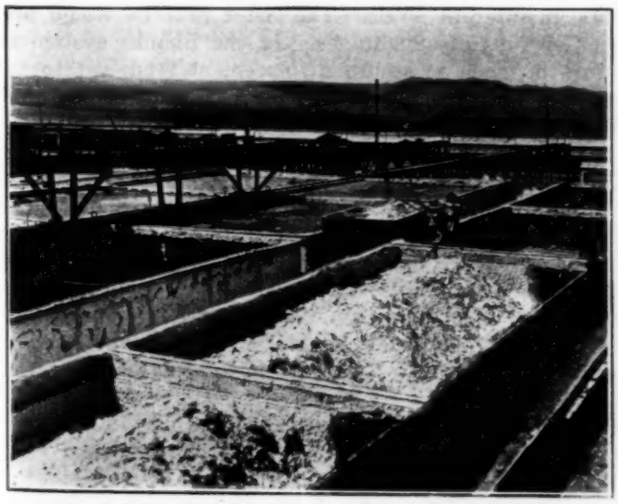
[6] Ibid., p. 27.
[7] Ibid., p. 15.
[8] Ibid., pp. 47-48.
[9] Ibid., pp. 37, 38.

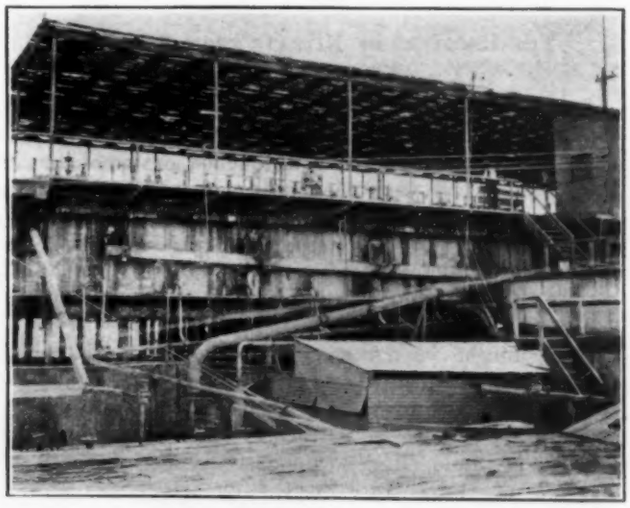












Nitrate cancha at an ordinary oficina
Crystallizing vats
Nitrate in crystallizing vats

Passenger electric car at a plant
Nitrate plant
Boiling vats (cachuchos)

enthusiasm has become much dampened as each heralded 'invention' went the way of its predecessors into the scrap heap."[10] I still think that "There is no justification for the extra expense involved in the classification of the small amount of slimy material found in normal crushed caliche and the treatment of the fines by any system of pressure or vacuum filtration. Owing to the refractory nature of the slime after the absorption of the nitrate solution and the difficulty if not impossibility of thickening or filtering a borra pulp by any known method, it is highly inadvisable to separate this from the sandy material, either purposely or as an unavoidable phase of any scheme of treatment adopted."[11]

Bouquets for the Gibbs Process Unwise

Dr. Donnan singles out the Gibbs process, now defunct, as forming probably "a genuine and courageous attempt to break away from the bonds of traditional practice"; investigators unconnected with names to conjure with in the recent technical history of the industry are apparently grouped as "would-be inventors or authors" who "fail to justify their ideas or suggestions by means of the publication of exact quantitative investigations. There seems little doubt," the professor continues, "that the vast majority of the so-called 'new processes' are simply paper propositions."

Visitors to the Chilean nitrate pampa should distribute bouquets with caution, for it may be possible that a genuine and intelligent attempt may best be made by the pampa technician to improve methods and processes by adopting an attitude of moral and intellectual honesty toward the researches of others and by a toleration of the views of "authors and would-be inventors" from divers phases of industry. Dr. Donnan's commendation of the Gibbs process at oficina Celia, "which he was unfortunately prevented from visiting owing to preoccupation with other matters," indicates an apparent divergence from a rule he has laid down for the guidance of others, to wit, that "on no account must the research department take any figures or data on trust. It is absolutely essential that they themselves should determine the data." Consistency is a jewel, especially among scientists.

The Recovery of Nitrate from Ripio Is a Promising Field

The problem of re-treating the ripio dumps of the Chilean pampa, we read, is one "which the research department must not leave untouched or unconsidered. They would feel very foolish if somebody came along some day and solved it over their heads." Dr. Donnan suggests that "Good systematic counter-current leaching in the cold, followed by recovery of the nitrate by refrigeration, might offer a solution or part solution of the difficulty."

Ripio might be described as caliche that has been impoverished of nitrate and enriched with salt and other compounds. Ordinary cold leaching would produce an exceedingly impure liquor, so far as nitrate was concerned; it would offer no opportunity for the selective solution of the nitrate to the exclusion of salt—an advantageous feature of the hot process. Dr. Donnan could find no reliable survey of the average percentage of nitrate in any dump in Chile, and hundreds of millions of tons of this so-called residue is scattered over the pampa. One can only conclude from this reticence that it will be voted bonanza material at some time in the future, when the industry has finished "picking the eyes" out of the deposit. I should say that the average nitrate content of the dumps of residue in Chile is about 9 per cent. It may be more or it may be less. I have heard many asservations of low ripio, but the absence of convincing data on total loss leaves me skeptical.

"In any case," states Dr. Donnan, "the result would only be the recovery of a dilute liquor." I see no reason for this conclusion. I found no difficulty in treating a typical ripio, with the following results: nitrate in charge, 7.8 per cent; nitrate in residue, 0.4 per cent; nitrate extracted, 95.5 per cent; time of treatment, about 24 hours. The ripio was crushed to about ½ in. The solutions used were aqua feble, relaves and the customary water wash. The first effluent showed that the abstraction of nitrate from the ripio amounted to over 100 grams per liter. The residue contained 13.3 per cent moisture.

Although some dumps may contain sections in which there is an excess of borra, it is probable that an aggregate taken over any considerable length of dump face would provide an excellent product for treatment. As a rule the average ripio is so clean that it might well form the body of a charge that included a proportion of refractory, high-borra caliche.

Alternative Methods of Operating the Shanks System

Advantages of Upward or Downward Displacement

Dr. Donnan asks whether "it would be an advantage or disadvantage to give up the original idea of a continuous slow downward displacement of denser liquor, and to circulate the liquor in each separate tank by pumps or other means." This question indicates an incomplete appreciation of the imperfections of Shanks-maquina operations. I maintain that: "Efficient displacement of solutions during leaching must take place either in an upward or a downward direction. This involves (*a*) pumping from vat to vat on any system of solution concentration; or (*b*) the erection of the vats at different levels. The latter practice would present obvious disadvantages. In the Shanks system an effort is made to secure displacement from vat to vat without recourse to pumping or variation in vat level. The result is that operations are considerably simplified, but at the expense of efficient displacement. . . . Caldo where formed is largely diluted with incoming caldillo . . . no true displacement takes place."[12]

The concentration of solution by pump circulation in individual cachuchos is already in practice in many maquinas, but in this case nitrate is removed by the solution to be put again in contact with the charge. It may be taken as an axiom that in all efficient leaching operations a progressive impoverishment of the charge is accompanied by a progressive diminution in nitrate content of the solution in contact with it.

Circulation of Liquor Produced Thermally

Dr. Donnan also asks: "Could external heating of the liquors be so arranged that upward circulation in each tank was produced thermally (after the well-known principle of thermal circulation) and not by pumps?" The "liquor" circulating from cachucho to cachucho in

[10] *Chem. & Met. Eng.*, May 17, 1922.

[11] "Recovery of Nitrate From Chilean Caliche," pp. 11, 12.

[12] Ibid., pp. 6, 7.

an ordinary Shanks maquina is so muddy that I do not know of any type of heater that would prove reliable for the purpose. However, if the fundamental principles of leaching are to be recognized, it may be mentioned that upward percolation is not only practicable but highly desirable, especially during the earlier stage of treatment. As a general rule, however, I am opposed to the use of pumps for the delivery of solution underneath the bed of caliche. The pressure fluctuates and often rises above the normal, thus disturbing the equilibrium of the charge, causing short-circuiting and poor average extraction. Gravity flow from a definite head is preferable, arranged so that the difference in density between the incoming and outgoing solutions is a little more than balanced. The great advantage of upward percolation is that the denser liquor resulting is delivered from the surface, thus obviating crystallization troubles in piping or other inclosed parts of the apparatus.

Desirability of Using Homogeneous Charge

Dr. Donnan has drawn attention to one of the weakest features of present practice when he calls for an investigation on the advantage of homogeneity of the material comprising the charge, both in regard to size and nitrate content. The nitrate, as a general rule, is not finely disseminated through the caliche. In a 20 per cent charge I have often seen masses of 60 per cent crystalline matter alongside 2 per cent costra. Thorough mixing of the various types of caliche usually treated is an essential preliminary to operations on an adequate unitary scale. A homogeneous charge, in so far as nitrate is concerned, is only possible after the adoption of much finer crushing than is practiced in a Shanks maquina.

Machinery Necessary in Finer Grinding

It is pertinent that attention should be drawn to the question of machinery suitable for the purpose. I am averse to rolls for the secondary reduction of caliche; they were tried at Chuquicamata and thrown out in favor of disk crushers. There is a great deal more minus 150-mesh material in average caliche than there is in Chuquicamata ore, so that consideration of the problem of the avoidance of unnecessary sliming should be more thorough on the nitrate pampa than it need be at the famous copper mine. Any earthy raw material—if crushed coarse, thrown into a "leaching vat" equipped with steam coils and a perforated-plate bottom support, submerged with solution, which is boiled—might be termed refractory; for it is certain that the disturbed slime would clog the space below the support and foul the solution abstracted for precipitation or crystallization, or sent forward to vats charged more recently. This is precisely what happens in the Shanks maquina. The trouble is due to the methods followed and the apparatus used; the borra is responsible for the resulting inefficiency because it is improperly handled. The cheap and efficient removal of soluble by gravity leaching necessitates the preparation of a mass that is evenly permeable. This condition can be obtained only by adequate crushing, thorough mixing and proper distribution; the permeability is obtained by the selection of suitable machinery, by the avoidance of overcrushing and the release of an excessive amount of slime.

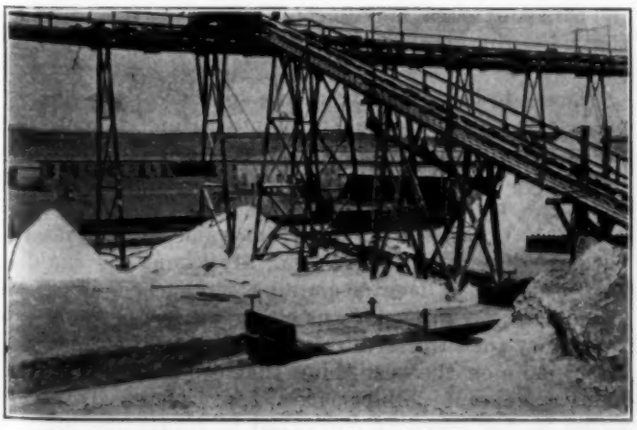
Suggested Use of Cottrell Precipitators for Settlement of Dust Unnecessary

In discussing the question of the settlement of dust, Dr. Donnan suggests that it might be possible "to arrange the crushers in closed wind-channels or wind-passages, and to precipitate and catch the dust by Cottrell or Lodge electrostatic precipitators."

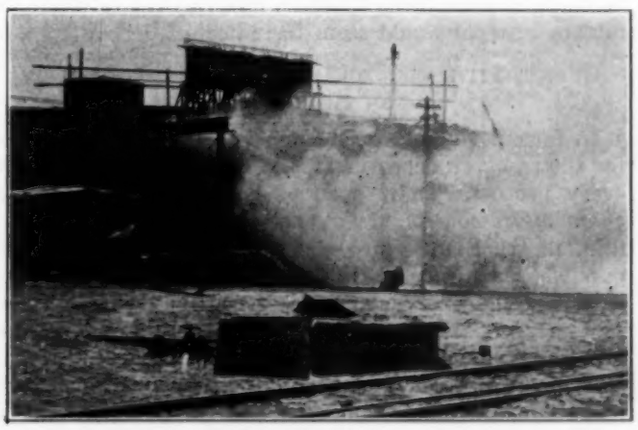
The accompanying photograph of a disk-crusher plant in operation was taken at an oficina commended by Dr. Donnan for its progressiveness. The escaping dust, which was of higher grade than the average of the caliche being treated, was distributed everywhere by the prevailing wind. I see no need for electrostatic precipitation. I think that the trouble could be lessened by the use of aqua vieja as a spray on piles of caliche, either on the pampa or in the bins. Incidentally, the evaporation of water resulting would save fuel. Dusting from a primary crusher is inevitable with small-scale operations. With large gyratory crushers, however, the dust problem is seldom insistent, even with the most refractory material. As far as secondary crushing is concerned, disk-crushers are especially suitable for arrangement so that no dust escapes into the atmosphere in or in the vicinity of the crusher building. If an attempt were made to solve the dust problem in the maquinas of the pampa, it would be found that one of the principal causes of damage to machinery, of dirt and general discomfort would be removed. Health and interest in the work cannot persist for long under the conditions obtaining in the majority of the oficinas.

Criticisms of Methods of Calculating Results Suggested in Donnan Report

If one thing is needed more than anything else in the Chilean nitrate industry it is the simplification of operations at every stage. Much depends on a quick and



NITRATE CANCHA WITH BELT-CONVEYING EQUIPMENT



SECONDARY CRUSHING PLANT

easy and comprehensible method of stating quantitative results which constitute an important check on operations. Dr. Donnan has incorporated some valuable mathematical calculations in his report, but unfortunately he has beclouded the application of them by the introduction of phrases that need considerable clarification. Thus we have the "nitrate extraction efficiency of the leachers" and the "tank efficiency," the latter being defined as "the percentage of the nitrate contained in the raw material which is obtained in the strong liquor run from the leachers (boiling tanks)." In the first place, "efficiency" is a word that should be used with caution on the Chilean nitrate pampa; in the second place, the amount of nitrate in the "strong liquor run from the leachers" is greatly in excess of that originally in the caliche. What is needed in the technical operations of any process such as caliche treatment is a recognition of the difference between theoretical extraction and actual recovery. The former indicates the amount of nitrate removed, as shown by analyses of caliche and residue; the latter is based on the yield of nitrate in cancha (drying and sacking platform) as compared with the amount sent to the maquina. The best indication of a satisfactory process is evidenced when actual recovery closely approximates theoretical extraction and when it is obvious that accurate sampling is feasible by ordinary methods.

Sampling Methods in Vogue on the Pampa

Dr. Donnan contends that the sampling methods noticed in use on the Chilean pampa usually were unworthy "of the time of Noah's Ark." Personally I think that this is a reflection on the care with which that gentleman selected his cargo. If he followed instructions, the result must have been a creditable example of early sampling, although it is possible that a number of smaller beasts escaped being counted when they rode in that famous two-by-two procession.

The average methods of sampling in vogue in a nitrate oficina operating the Shanks process are such that no reliance can be placed on the accuracy of the results. Many different types of ripio may be discharged to the dump, the nitrate in the portion coming from above the crinolina plates in the cachucho being used invariably as an index to the efficiency of operations. "Because of the difficulty of sampling so unhomogeneous a mass as the material fed to the cachuchos, the impossibility of estimating the tonnage of the various ripios discharged and the wide variation in nitrate content in the individual pieces . . . the actual yield of nitrate usually indicates a loss amounting to twice or even three times as much as the estimate of nitrate in ripio would seem to indicate."[12]

Quantitative Control a Practical Impossibility on the Pampa

In formulating an extensive program of investigations for the research department, Dr. Donnan maintains that every process, "be it good or bad, is under *accurate quantitative control.*" I repeat the italics, but I maintain, in the Shanks process, that though this may be possible theoretically, it is impracticable when considered as an everyday phase of routine duties. Take, for instance, the question of the estimation of nitrate in borra, which is correctly described as a semi-liquid sludge with 16 to 25 per cent of nitrate. The nitrate may occur in small lumps of untreated caliche, as a strong solution, as original or redeposited crystals, as adsorbed salt or associated moisture in contact with colloidal clay and granular sand. This sloppy though valuable mess is usually shoveled into dump cars placed below the discharge doors of the cachuchos. To avoid undue spilling, the cars are loaded only about half full; the borra consists mostly of coarse sand and nitrate crystals in the bottom, with slime pulp and fine sand of varying densities at different levels. Correct sampling and tonnage estimation is impossible. The mass is of varying nitrate content and the car is usually caked with old ripio. The conditions of dumping are dirty and unsatisfactory; if the research department evolves during the day a scheme for the correct estimation of nitrate so discharged, it will be disregarded during the first night shift. To expect intelligent men to maintain enthusiasm over such a job connotes a disregard of the fundamental fact that a so-called leaching process which delivers a residue (*sic*) in such a condition is either being operated badly or is entirely unsuitable for the purpose.

A glance through Dr. Donnan's report will convince one that standardization of weights and measures is unknown on the Chilean pampa. Not only does this involve a pitiable waste of time and labor, but many of the results are valueless for comparative purposes. In few other industries are the advantages of adopting the metric system so obvious; if a research department be formed, the members should be permitted no personal latitude in this respect. Opponents to the metric system often maintain that it is seldom practicable to displace entirely the older units. In Chile it is mentioned that though the metric system may be used for control work, the final record of salitre (commercial nitrate) must be given in terms of the Spanish quintal of 45 kilos. This anomaly, one is glad to note, has now been overcome and the association is quoting all prices per metric quintal of 100 kilos.

Field for Scientific Research

I am, and always have been, a vigorous supporter of scientific research, not hit-or-miss experimentation; but I also believe that much depends on the careful selection of a promising field for investigation in the first instance. The prospective group of doctors of science and philosophy proposed by Professor Donnan might well spend their lives, until the pension age was reached, and their children and grandchildren after them, in obtaining scientifically accurate information about the working of the Shanks process under the varying conditions obtaining in the two hundred odd oficinas on the Chilean pampa, only to confirm existing knowledge—that, in nine cases out of ten, it is hopelessly inefficient.

Thanks to the initiative of the sponsor of the Shanks process in Chile, James (Santiago) Humberstone, the method has well served its purpose; it has enabled the industry to reach a high state of prosperity; and it has been responsible, in no small measure, for Chile's present-day position in the front rank of progressive nations. Conditions, however, are changing rapidly. The beds of caliche remaining untouched must be classed, for the most part, as either too low grade or too refractory for successful treatment by existing methods. In my opinion the best thing that could happen to the industry, except possibly in a few isolated instances, would be for everyone concerned to forget the Shanks process.

[12] Ibid., p. 3.

Improved Automatic Regulator for Pressures Below Atmospheric

By W. A. Jacobs and P. A. Collins*

IN THE EXAMINATION of crude petroleum and some of its products, it is frequently necessary to obtain high-boiling fractions that cannot be distilled without decomposition ("cracking") at atmospheric pressure. Dean and his co-workers[1] state:

> The separation of the residue boiling above 275 deg. C. (527 deg. F.) or 300 deg. C. (572 deg. F.) into further fractions of various ranges of volatility can be made without cracking either by a steam or a vacuum distillation. Distillation in the presence of a current of open steam is almost universally used in commercial refining and frequently in the laboratory. In connection with a quantitative analytical method, however, there are numerous complications and it seems preferable to use the scheme of vacuum distillation. Either of these methods accomplishes the same fundamental purpose of reducing the boiling point of the oil. Boiling occurs when the vapor pressure of the oil slightly exceeds the pressure of the atmosphere above it. The temperature at which a liquid boils can be lowered either by balancing part of this atmospheric pressure with the vapor pressure of a current of steam, or by reducing the atmospheric pressure by means of an evacuating pump. The latter method permits easier control and is more suitable in the laboratory.

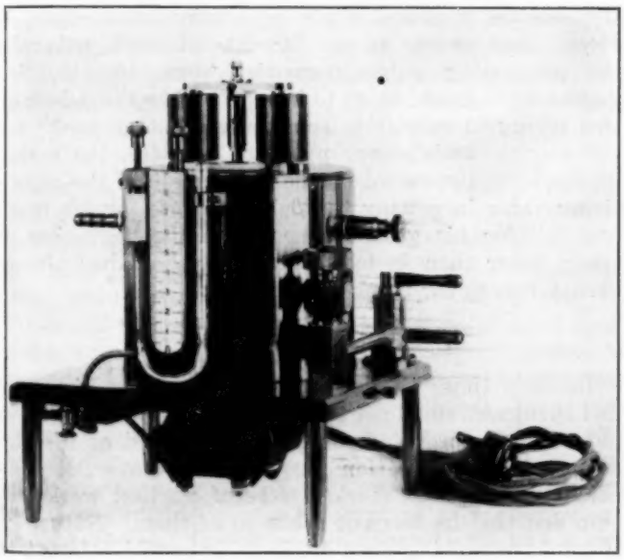


FIG. 1—PRESSURE REGULATOR DEVELOPED BY BUREAU OF MINES

This same bulletin describes the apparatus and methods used in making vacuum distillations, and describes two types of manually operated and one automatic pressure regulator for maintaining a constant "vacuum." The actual pressure used for this class of distillations in the bureau laboratories is 40 mm. absolute, which corresponds at sea level to a "vacuum" of about 28 in.

The automatic regulator described by Dean was entirely successful and has been in use for over 2 years in one of the bureau laboratories. It has, however, been necessary to build additional regulators from time to time, and a number of improvements have been incorporated in each one, so that the latest model is considered much more simple to construct, more compact and neater in appearance, more sensitive and more foolproof than any of the earlier models.

The principal parts of this regulator are a cylinder 4 in. high made of 5-in. brass tubing with sealed ends, which serves as a reservoir, two electromagnets which operate the air inlet valve, a main valve, supplemented by a needle valve, on the tube connecting with the vacuum pump, a 110 to 6-volt transformer, a fixed condenser to prevent "sparking," outlets for connecting to the distillation system and to the vacuum pump, and an adjustable regulating manometer equipped with a movable scale. The adjustable manometer makes it possible to carry on distillations at different pressures at will.

Working drawings of this apparatus have been completed, and its manufacture will probably be undertaken by several of the apparatus supply houses. Fig. 1 shows practically all parts of the apparatus.

Published by permission of the Director, U. S. Bureau of Mines.

*Chemical Engineer, and Instrument Maker, respectively, Pittsburgh Experiment Station, U. S. Bureau of Mines.

[1] Dean, E. W., Hill, H. H., Smith, N. A. C., and Jacobs, W. A., "The Analytical Distillation of Petroleum and Its Products," Bull. 207, Bureau of Mines, page 19.

Patenting Process for Wire

A paper recently read by R. C. Helm before the American Iron and Steel Institute entitled "Use of Liquid Fuel in Metallurgical Furnaces," contains some interesting information on the so-called patenting process used to soften and toughen wire before drawing it through dies, and the kinds of furnaces usually installed for performing the operation.

"Old process" patenting is effected in a continuous furnace in which the rod or wire is heated to 1,700 deg. F., then cooled in air. In "double lead patenting" the rod is passed through a lead bath heated above the critical, and immediately passes into another at a temperature just below the critical. The latter scheme gives the strict temperature control necessary for high-carbon material.

Older coal-fired furnaces were made of massive brickwork to act as a heat reservoir so that variations in firing would have less effect on the metal. Long narrow furnaces were used; the flame passed lengthwise from end to end, then back through an upper compartment, escaping at the fire end. Wire or rod was threaded through small perforations in the fire arch, as shown in the sketch, Fig. 1.

Less coal is burned if the wire passes through the upper compartment, bathed in the waste gases. When using oil fuel the lower compartment may be flared out from the burner, and the hottest portion of the furnace is then at the end discharging the wire.

Double lead patenting is done in furnaces of the same general type. The high-temperature pot is placed over a perforated arch at the end of the furnace farthest from the burner. Spent gases travel back again above the fire arch in opposite direction to the cold wire as it enters, giving it a preheat before it enters the pot. The second or cooler pot is placed just beyond the furnace and is heated largely by the hot wire entering it. A quenching furnace has a bath of cold oil in place of the second lead pot; hardened wire then passes into a separately heated oil bath to draw the temper.

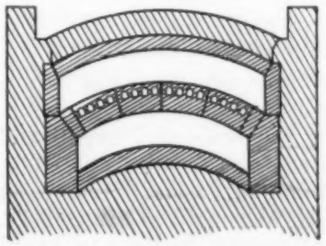


FIG. 1—CROSS-SECTION OF COAL-FIRED PATENTING FURNACE

Trademarks

What Is a Trademark?—Brand Marks Versus Names of Products—Why Select a Word for a Trademark Which Cannot Be Exclusively Appropriated?—Why Undermine One's Business Good Will by Using a Trademark as the Name of a Product?

By Clayton L. Jenks
Patent Attorney, New York City

STRANGE customs are growing up in the advertising field which unless checked will either store up future trouble or require a modification of our trademark laws and a reversal of our court precedents. The difference between a trademark and a name of a product seems to be misunderstood not only by chemists who should know how to protect their marketed discoveries but even by many advertising and sales men who originate trademarks and are supposed to be their foster-parents. How many people can analyze and define the trademark rights involved in the following well-known words: Aspirin, Bevo, Castoria, Cascarets, Celluloid, Coca Cola, Coffee, Colgate's, Corn Flakes, Elgin, Fatima, Featherbone, Ivory, Kodak, Linoleum, Lux, Lysol, Mazda, Mazola, Pantasote, Postum, Pyrex, Pyroxylin, Quaker Oats, Resinol, Sapolio, Shredded Wheat, Singer, Vaseline? What is a trademark?

A tribe of Indians acquired a fancy for a certain brand of cove oysters put up in cans which bore on the label a picture of a dog's head. Being uneducated denizens of the prairie and unfamiliar with the taste of sea food near its native habitat, they have always believed that this particular delicacy was canned dog, and woe unto anyone trying to palm off other brands for their beloved dog!

Absurd as such an interpretation seems, a large number of educated people are similarly using trademarks as names of products and deliberately undermining their own businesses. Why did "linoleum" change from a valuable exclusive trademark asset to a mere common name of doubtful value? In the average popular magazine, on the street cars, everywhere, one sees advertising built around some special word which either is inherently unfitted for use as a trademark or, originally being a good trademark, is improperly used. Why is it that many a business good will is built upon quicksand when rock foundations are freely available? There is a surprising amount of ignorance as to the function of a trademark, and yet the whole subject is based upon a few simple fundamental principles which should not be ignored.

Origin and Function of Trademarks[1]

From the time of the Neolithic age there has been a strong necessity for identifying particular manufactured goods. The stones of the walls of Pompeii and pottery found in Egypt, dated from 6000 to 1200 B.C., have borne crude illustrations of horns, trees, jugs, bees, animal heads, etc., which were used as trademarks. It is interesting to note that similar trademarks found in Greece, Upper Egypt and Hungary have indicated a common civilization around the Mediterranean long before Egypt acquired a civilization of its own. A jar of fish sauce found in Pompeii bears the inscription "Scaurus' tunny jelly, Blossom Brand, put up by Eutyches, slave of Scaurus." Note the use of the proprietor's name as well as the special trademark "Blossom."

As that particular tunny jelly sold in Pompeii, or the Damascus sword blade or a clay brick made in Moses' time became known for especial merit, naturally the purchasing public demanded some identification mark on the goods so as to know whether the salesman was trying to substitute something "just as good" for the original satisfactory product. Likewise, the maker of the jelly, the sword or the brick realized the advertising value in getting the public to look for his mark and ask for his goods; hence from the beginning of trade, other than in local bartering, there has always been a reason for using a trademark.

Use of Marks Explained

In early times the maker could not write his name and customers could not read it, hence the peculiar mark put on the sword blade or the brick served as his signature for identification purposes. Moreover, it indicated that goods so marked were of his best workmanship and that he was not ashamed of them. Naturally, if he were making poor products he would attempt to sell them by surreptitious methods.

We today have the same method of branding, particularly on goods such as nails and small tools, which are not capable of carrying long names or elaborate picture designs. However, the main difficulty with wordless marks is that the purchaser has no ready name for the mark and so must see the goods for identification and point them out to the salesman. Obviously, this tongue-tied system has its drawbacks. Hence such symbol marks are more ordinarily used in association with words, such as the peculiar mark found on the end of the cracker package put out by the National Biscuit Co. which is labeled "In-er Seal." Similarly the brand of evaporated milk which bears the picture of a bird carries the name "Eagle" so that one may not mistake its identity.

Ordinarily a word is used without illustration and it is in this use of words alone that our modern difficulties largely arise. The purchaser of Eagle condensed milk knows that he is obtaining the milk of cows. Similarly a buyer of Star soap knows that it is not of stellar origin. On the other hand the average person may not know that Aspirin is not the chemical name of the product and that the material is in reality "acetylsalicylic acid." It is this use of the trademark as the name of the product, due to the manufacturer's failure to provide a satisfactory name or to the public's indifference or its inability to understand correct trademark usage, that works the greatest harm.

A trademark is a part of the intangible good will which the public holds toward a business person,

[1] These historical data were derived from Rogers on Good Will, Trademarks and Unfair Trading, published by A. W. Shaw Co. of Chicago. This book gives a clear non-technical exposition of the subject and is well worth reading.

Chem. & Met., Dec. 6, 1922.

whether individual or a company, who makes or sells a branded product. It is the first and main duty of an advertising man to build up and safeguard this good will. The owner of the business should know whether that good will is being injured or fostered. The prime purpose of advertising is not to obtain an order here and there, but it is to educate the public as to the use and advantages of a new article and the manufacturer's business service, to arouse a popular interest in both the company and its goods, and to create a potential friendliness or good will which ultimately results in prosperous business. A trademark from this viewpoint should be the most prominent part of the advertising, which is meant to remain clear in the mind of a potential purchaser. The latter is not supposed to remember all the virtues of a particular trademarked article, but if he acquires a good impression from reading the advertisements, he subconsciously carries that good impression intertwined in his mind with a word which is prominently displayed, whether it is the trademark or some other word. That word should be the trademark.

Haphazard Choice of Mark

When a patented article is first put on the market, and particularly a chemical product, the organizers of the company may appreciate dimly the advantages in having a good trademark; yet they may carelessly select some word which cannot be registered or they may deliberately misuse a registrable word as a mere trade name under the delusion that the name will always be their exclusive property. Unless a careful preliminary study of the trademark situation is made, many and serious difficulties may arise in later protecting the business good will.

It is a common occurrence for a new trader in the field to go to the expense of adopting a trademark only to find that he is infringing another's rights and is subject to an injunction stopping his business and to an accounting of his profits. Not only should the utmost care be taken to insure having a proper word which does not infringe and using it correctly, but one should, as far as possible, test the psychological effect of the use of the word upon a large number of persons representing the purchasing public and otherwise endeavor to determine its advertising advantages.

As a serio-comic illustration of the possibilities for trouble inherent in a trademark, the American name of an automobile proved unpopular in Spanish countries during the early days of the industry, when automobiles were both a novelty and a menace. Upon investigation it was found that the translated name meant "criminal"!

It is a common error for a new trader to choose a word which describes the article or its advantages. If the product is a new shaving soap, he may decide to call it "Heavy Lather," or if a razor, "Fast Shaving." Or, weakly following the custom in his particular art, he may mall a floor covering "Baboleum," indirectly suggested by the popularity of "Linoleum." In the latter case, thinking possibly that Baboleum is the name of his floor covering, because Linoleum is a name, he sticks a blue label on the back of the rug and misguidedly advertises for the public to "look for the blue label," totally failing to realize that there is little trademark value in any such spot of color and that whatever the public retains from reading such advertisements or seeing such labels is centered, not around the blue color, but around the main word "Baboleum."

Such a manufacturer is headed toward trouble. Some competitor, realizing the strides of this first man's business, may decide that he too must market a "heavy lather soap" or a "fast-shaving razor" and he puts out competing products and so uses the same words to describe his goods as to draw a share of the trade. The first man, taking his aggrieved feelings into court, finds to his surprise that he cannot monopolize any such description as "Heavy Lather" or "Fast Shaving"; and the court merely mildly enjoins the competitor from unfair practices, but leaves him open to the free use of such descriptive words. Then all that is left to the first man is his own business name, which may not have been emphasized in the advertising and which will now cost a large sum to get it properly before the public.

The word "Aspirin" as found on a drug used to mean that the material so labeled was made by the Bayer Company. The court has, however, recently decided that the trademark word was a common name so far as concerned the retail trade, so that a druggist might sell "Aspirin" of any company's make under that name. As a result the original users of the mark were obliged to undertake a campaign to advertise the name "Bayer" and ask the public to "look for the Bayer Cross" made up of the two words "Bayer" arranged in a cross shape on each tablet. Why was this trademark "Aspirin" thus thrown into the public domain?

Trademark—A Common Law Right

It is difficult to understand why the originators and users of a trademark do not appreciate the value of a word mark capable of being monopolized or why they are so shortsighted as to build up a trademark only to lose it. A trademark should last as long as the business lasts. Perhaps such people have vague dreams that a descriptive word such as "Fast Shaving" for razors or a mere dictionary name might be retained exclusively in their business, but common sense considerations should teach them otherwise. Trademarks are founded not so much on a large body of laws and decisions, which indeed there are, as upon ordinary everyday common sense, and the function of the court in the average trademark dispute is merely to apply that same judicial common sense.

A patent is a right granted by the government under which a monopoly for 17 years is obtained for excluding others from making, using or selling the product of an inventor's brain. The monopoly ceases at the end of the period and the public thereafter has full rights to the invention. Similarly, an author or artist may obtain a copyright monopoly giving him the sole right to publish or make copies of his work for a limited time. Patents on inventions and copyrights on writings and paintings are monopolies created by law. A trademark, however, implies that there is no monopoly and that the mark is used to distinguish the goods of one maker from similar goods of a competitor. There is no monopoly except in whatever rights a user has to the trademark itself.

A trademark is a designating symbol or word which stands as a short signature of a manufacturer, as a means of indicating the origin or ownership of goods, as a memory guide to which the public attaches its good will for a particular make of goods, and at times as a sign of quality and guarantee of the trader's good will toward the public. One chooses a trademark, therefore, to identify his own goods and differentiate them from those of his rivals.

A trademark is not a government-granted right. It

is a common law right. It is a squatter's right, an explorer's right. He who first penetrates a new land unclaimed by others, under the law of all time, is entitled to that land. This is a fundamental principle embodied in the very make-up of the human being. Similarly, when a person adopts a trademark, he is pre-empting and claiming exclusive rights to a field never before occupied; but let him see that there are no adverse claims to his field when he enters it and that the public be not allowed to trespass later. Therein of course lies his danger.

Two Classes of Trade Words

With these principles in mind, it is now seen that a partial answer to our main question is that there are two classes of words used as trade symbols: (1) technical trade or brand marks; and (2) trademark names.

A genuine technical brand mark is easily picked out. These are the words which truly indicate the origin of the goods and stand as a short signature for the manufacturer's or trader's name. For example, Old Dutch Cleanser, Eagle milk, Quaker oats, Lysol disinfectants and soaps obviously comprise strong brand-marks.

The term "trademark name" is used herein in a narrow sense to indicate that class of trade words which are used as names of products, but which have trademark functions and indicate the manufacturing or sales origin of the goods. A name of a product, unless it has trademark qualities, is not registrable, or if it has been registered may be later removed from the official records, when it no longer serves as an exclusive designation of origin. Originally, linoleum was a trademark. It was used as a trademark name. Now it is a mere common dictionary name without trademark value.

A further class of words relate to a business and its good will rather than to a particular commodity. Such trade names as company names may become of great value, but unless they are registrable as exclusive trademarks, they serve but poorly to protect one's business. If the company name has been arbitrarily coined, it may ordinarily be maintained as an exclusive mark; but if it is a common name like Baker or Rogers, the difficulties involved in keeping all other Bakers and Rogerses out of the same field are formidable, as has been the case in connection with the use of these names in the chocolate and silver industries, respectively.

When a new chemical is discovered, it is given a name, like the name of a basic element, and this name is necessary for the public to use in referring to that particular material. Everyone has full rights in using that name and no one may use it as an exclusive trademark. On the other hand, a trademark is supposed to identify a particular business and certain goods of a trader, and not to apply to similar goods made by one's competitors. Unfortunately, many chemical manufacturers in marketing a new and unnamed product do not provide both a name and a trademark but economically try to make one word do for both. It will not do! Remember that a trademark is the signature of a person and not the name of an inanimate object. A trademark name has not all the characteristics of a trademark; hence the public or a competitor may some day tear down whatever good will lies in that word and use it merely as a common dictionary word descriptive of a product made by anyone.

We shall not attempt to point out the strong as distinguished from the weak trademark names, as the distinctions are very fine, and some of the weak ones may yet be reclaimed before it is too late. How this can be done after one has let competitors into his trademark field is not the purpose of this article. Suffice it to say that the way is rough and stony.

Trademark names should be considered from two viewpoints, depending on whether they are applied to patented or unpatented products.

Patented Products

When the original makers of "Linoleum" floor covering marketed this product, they coined an arbitrary word to designate it and theoretically had a good trademark. They had, but they did not use it as a trademark exclusively. This floor covering was a new product, and patented so that no one else could make it. Instead of adopting a separate descriptive name by which the public might differentiate it from all other flooring materials, the makers chose to use their exclusive trademark "Linoleum" as a trademark name and the sole name of the product. When the patent expired and others had a right to make the flooring material, they had no other name for this material and naturally adopted the same word "Linoleum," merely stating that this was "Smith's" or "Jones'" Linoleum instead of the product made by the original Linoleum company. The court upheld this state of affairs, holding that since there was no common name for the material which the public could use, it had a right to take the name which had heretofore been considered a trademark by its owners and use such name in a descriptive sense to name the flooring material; but competitors of course were obliged to make it clear to the public that they were not the original company.

Following this decision the courts have thrown into the public domain such trademarks as "Castoria," "Singer," "Featherbone," "DeLong" (hooks and eyes), "Webster" (dictionary) and "Aspirin."

In the Castoria case, the court held that the name Castoria as first used by Dr. Pitcher may have been indicative of the manufacturer—i.e., have trademark functions—during the life of the patent, yet when the right to manufacture and sell the compound became universal anyone might call his compound of the same formula by the name Castoria. It should be particularly noted that "Castoria" was used by Pitcher for 10 years after his patent expired before the second man adopted it, nevertheless the court held that this matter of time made no difference. Since the word had become the name of the thing and public property, it could not thereafter be reclaimed as a trademark.

In connection with the Singer Sewing Machine, it was decided in an opinion rendered by the late Chief Justice White that the name "Singer" indicated to the public a class and type of sewing machines and so was generally descriptive. The court, however, held that while others might use the name Singer if they made the identical Singer machine, nevertheless this right was subject to the condition that the name must be so used as not to deceive the public into mistaking the second manufacturer for the original Singer company.

Similarly, copyrighted names are subject to seizure by the public, as decided in the famous Webster Dictionary case. During the term of the copyright the proprietor has a monopoly of the book as well as the name, but both name and book pass into the field of public right when the copyright expires. However, it is to be emphasized that the court endeavored to protect

the G. & C. Merriam Co., the original publisher of the Webster Dictionary, by holding that the word had acquired a secondary trademark meaning by the public's acquiescence; hence *prima facie*, the second man was not entitled to use the word except under rights which were secondary to those of the Merriam company. That is, he must neutralize any false impressions which might be created and unmistakably inform the public that the book is of his own publication and not that of the Merriam company. The courts therefore place the burden upon the second man and not upon the first user of the trademark to distinguish between the two makes of goods.

It may, however, be stated as the law of the English-speaking nations that a trademark which is used as the name of a patented article will become public property when the patent expires, if such word is the sole name by which the public has come to know the patented article. It is of vital importance that manufacturers understand this theory of trademark usage. Anyone checking up the advertising in the average popular magazine or cards in the cars will find a great many trademarks which are going headlong into the public domain. Some advertisers are so kind to the public as to place their patent dates on the trademarks, telling when the patents expire! The failure of advertising managers and salesmen to understand this danger is appalling, considering the immense sums of money which they are expending in building up such trademarks, merely to have them taken away by a competitor when their patent rights are gone.

Unpatented Articles

As to the unpatented products, the courts have attempted so far to protect the trademark names applied thereto, but Lord Kay in his famous summary of the law of names has stated that if the maker of an unpatented article has slept upon his rights and permitted the name to be used by others until it has become public property, the court will not interfere. Moreover, it is difficult to say how far away is the day of reversal of the former lenient attitude of our courts and legislatures. Attempts have already been made to destroy many valuable trademark rights. For example, as a result of the German chemical situation, a bill was introduced in Great Britain in November, 1917, to amend the trademark laws. This bill, which was sponsored by such prominent men as Lord Parker, a leading judge, and Sir Albert Stanley, President of the Board of Trade, provided that a word trademark used as the name of an article should be removed from the Register of Trademarks. The chief reason underlying this bill was that if a trademark were used as a name it thereby gave a perpetual monopoly of a business so that it would be impossible for competitors to get on the market unless they could use these same household trademark words. In their panic the British misconstrued the nature and function of a trademark and proposed to go back to harsher rules than ever before applied and they even extended their ill will to cover well-known American trademarks. The protests from this country and the final calm judgment of British business men and attorneys ultimately killed that portion of the bill. It was considered that, with due regard to business ethics and fair play, every new man in the field should build up his own trademark and not attempt to profit by the advertising good will of the earlier competitors. We have, however, no guarantee that such a hostile theory of trademark usage may not some time be enacted into law. Small manufacturers are likely to back trademark legislation which penalizes any large manufacturer, and anti-trust laws may go to the extent of declaring our well-known trademark names to be public property.

This British belief concerning the monopolistic nature of a trademark business—this does not refer to the monopoly in the word itself—seems to be echoed in the minds of many American advertising men—i.e., if they use a trademark word as the sole name of a product, they thereby acquire a perpetual monopoly in that product without regard to their short-lived patents. But in their overzealousness they defeat their own ends. Peculiarly, they do not appreciate the fact that a trademark properly used is a perpetual right, and they strive to attain something even greater than a trademark, which will give them not only a trademark monopoly but a perpetual quasi-patent monopoly as well. The fallacies underlying their beliefs are clear. First, there is no perpetual monopoly in a trademarked business, since obviously if the original makers should change their product and put out an inferior grade, or, as is more likely, if some new product appears which tickles the popular fancy, then competition must be faced and new trademarks will rapidly come to the front and undermine the original business. In the second place, the use of the trademark as a name negatives the idea of monopoly, since a name belongs to the public and does not primarily indicate the origin of the goods. As the advertising of a trademark name progresses, the more familiarly the public uses it; hence the more popular the mark the more insecure are the trader's rights in it.

It must not be understood from the above discussion that trademark names will not be protected by the courts. On the contrary, our courts will go a long way toward helping a man out of his difficulties by ascribing a secondary trademark meaning to a trade name. Moreover, one may perfectly properly decide to use a trademark as a name and he will be protected from unfair competition and the unethical practices of competitors trying to capitalize for their own benefit the advertising good will which the first man has built up. Many well-known trademark names are so valuable that it would be a harsh court indeed which would throw such words open to the public; yet we have the "Aspirin" and "Linoleum" cases as warnings that a trademark name, however popular it may be, may under certain circumstances be legally held to be a part of the public domain.

An analysis of the trademark situation for a manufacturer about to enter the chemical field may resolve into the question as to whether he can obtain greater commercial advantages by using his trademark as a name or by using it purely and solely as a brand mark for a described product. The answer should come easily. Merely by describing his product, giving it a name and using his trademark as a brand mark, he can protect the business good will. Why, if it is so easy to do the thing right, should one wish to take chances? It is not ordinarily difficult to describe a product, however complex its composition and structure may be. The public does not demand and in fact does not want a detailed description of the goods it purchases. For example, "Pepsodent" tooth paste bears the phrase "pepsin-bearing tooth paste" as the name of the material. This undoubtedly is sufficient description, since a chemical analysis of the actual ingredients present is

of no interest to anyone but competitors, who can make their own analyses.

The point is: Use some kind of a descriptive name to describe your goods so that the public will not think that the trademark is a mere name and so seize it for its own use. Surely, one's advertising campaign is as effective and the popularity of the goods as easily assured if the goods are identified by a proper trademark instead of a trademark name. No one can gainsay the popularity of such well-known brand words as Ivory and Fairy for soaps, Gold Dust for washing powders, or Fatima for cigarettes. These are proper trademark words and are clearly not the names of products.

If one but remembers the customary usage of trademarks as built up from the beginnings of trade and use the words as brand marks which specifically identify and distinguish one man's goods from another's, he cannot go far wrong. To furnish such identification, the trademark word must be carefully selected so as to be capable of exclusive use and then its user should fight with all his powers to keep competitors out of his domain, and to educate the public to know that such trademark always stands for a particular line of goods and as a synonym for the trader's name.

RÉSUMÉ

A trademark is a brand mark, a short signature, a mark serving to identify the maker and the origin of the goods. It is not the name of a product. It is one trader's brand of that product and should be used to distinguish his goods from another's. A trademark implies competition, not monopoly. It distinguishes between competing goods. Why try to use a personal signature as the name of an inanimate object?

Legal Notes

BY WELLINGTON GUSTIN

Decision on Chemical Control Act Not Reviewable

In a recent case the Court of Appeals of District of Columbia has upheld the ruling of the Secretary of the Treasury of the U. S. on his interpretation of the dye and chemical control act, approved May 27, 1921, saying that the Secretary has the implied authority to interpret the act because that is necessary to the performance of his administrative duty. This act operates to extend a privilege to manufacturers of certain chemicals and their substitutes, and Congress rightfully fixed the conditions under which the privilege should be enjoyed, one of which was that the Secretary of the Treasury should administer the act.

FUSEL OIL HELD NOT TO COME UNDER ACT

The provision in dispute was title 5 of the act, which reads: "No synthetic organic drugs or synthetic organic chemicals shall be admitted to entry or delivered from customs custody in the United States. . . . unless the Secretary [of the Treasury] determines that such article or a satisfactory substitute therefor is not obtainable in the United States . . . in sufficient quantities and on reasonable terms as to quality, price and delivery," etc.

The Secretary issued an order on Sept. 30, 1921, that fusel oil should not be considered to be a synthetic organic chemical within the meaning of the act and that permits for its release from customs custody were not required.

Exception to this order was taken by the Commercial Solvents Corporation. This company manufactures, at its plant in Indiana, butyl alcohol, which it claimed could be used, and was in fact being used, by practically all of the former users of fusel oil as a satisfactory and efficient substitute for that oil. It contended that fusel oil is a synthetic organic chemical and that its entry into the United States is prohibited by the act, since the corporation's plant had ample capacity to manufacture a satisfactory substitute for it and is able to supply all the needs and demands for such oil, and offers the same for sale at a reasonable price, and on even and equal terms with all purchasers, having regard for the quantities of their purchases, any difference in price being merely sufficient to equalize the difference in the cost of selling in large or small quantities. It also alleged that, if the Secretary of the Treasury should permit the importation of fusel oil in accordance with the order mentioned above, the company would sustain great loss and damage. Hence the company came into court to obtain an injunction forbidding the Secretary to give any instruction to any Collector of a Port of the United States permitting the importation of fusel oil except in the special cases provided for in the act. The Supreme Court of the District of Columbia refused the injunction and the Commercial Solvents Corporation appealed.

SECRETARY'S DECISION NOT REVIEWABLE

The corporation alleged that various importers and would-be importers made representations to various bureaus and officials of the Treasury Department to the effect that such oil is not a synthetic organic chemical; that these representations were considered by such officials as Chief of the Dye and Chemical Control Section, Chief of the Customs Division and Secretary of the Treasury. Further it alleged that the Secretary decided that fusel oil was not a synthetic organic chemical and that its importation was not prohibited by the act. It also alleged that this decision, made after the consideration just mentioned, was not correct and asked its reversal on the assumption that the court has the right to exercise its independent judgment with respect to the facts set forth in the bill and decide the case on its merits—in other words, that the court has a right to substitute its judgment for that of the Secretary, if it thought he was wrong, even though he was acting within his jurisdiction when he rendered his decision.

The Court of Appeals upheld the lower court in its holdings. The authority given to the Secretary by the dye and chemical control act to administer that act carries with it the implied authority to interpret it, because interpretation is necessary to the performance of his administrative duty. Nor can the courts review, by mandamus or by injunction, a decision of the Secretary of the Treasury, made within his jurisdiction, to interpret the chemical control act, if he did not act in a capricious or arbitrary manner. The Chemical Solvents Corporation did not charge or contend that the Secretary acted in a capricious or arbitrary manner, and it has been established in other cases that whether the Secretary's decision be right or wrong, that is not the question. It is his duty to decide as he thought the law was and the courts have no power whatever under those circumstances to review his decision.

Determining Combined Nitrogen in Iron and Steel

By Louis Jordan and F. E. Swindells
Chemist and Assistant Chemist, Bureau of Standards

THE only form of nitrogen ordinarily determined in steel is that combined as nitride, either of iron or of some of the other constituents. Tests for the presence of hydrocyanic acid or cyanogen on solution of steel in acid have been negative[1] and all the combined nitrogen is generally regarded as being present as nitrides. It is readily conceived, however, that part of the nitrogen present is not combined, but is either dissolved, adsorbed, or mechanically held. Iron, manganese or silicon nitride may be present in an ordinary steel; others are possibilities in alloy steels.

Allen Method for Combined Nitrogen

The usual method for the determination of combined nitrogen in steel is a modification of that employed by A. H. Allen[2] in 1880. Allen dissolved the sample of drillings or millings in hydrochloric acid of specific gravity 1.11. When solution was complete, it was made alkaline with lime, the ammonia distilled off and determined with Nessler solution. H. Braune[3] employed this same method, but specified that the solution should be filtered before distilling. He also used caustic soda in the distillation instead of lime.

In the 1918 edition of Blair's "Chemical Analysis of Iron and Steel" the Allen method is given with several modifications made by Langley, chiefly in the treatment of the caustic soda solution with a copper-zinc couple to remove nitrates and nitrites. Boussingault[4] had called attention to the fact that nitrates and nitrites during distillation were partly reduced to ammonia by the ferrous hydroxide present.

Another method for the determination of the ammonia in the distillate was proposed in 1907 by Petren and Grabe.[5] This consisted in collecting the distillate in standard sulphuric acid, the excess acid being determined by the addition of potassium iodide-iodate solution and titration of the liberated iodine with standard sodium thiosulphate solution. Hurum and Fay[6] have recently recommended the iodide-iodate modification of the Allen method for nitrogen determination.

In 1915 Tschischewski[7] studied the Allen method and made several improvements. He used standard sulphuric acid to collect the distillate containing the ammonia and titrated the excess acid with standard alkali. He had previously objected to the use of the Nessler method for the determination of the ammonia in the distillate because of the probable presence of amines.[8] He also pointed out the probability of error from alkali dissolved from glass condensers, and warns against unprotected rubber stoppers in the distillation apparatus if the Nessler method is employed.

As has been stated by Tschischewski, the size of the blank correction in this method is greatly influenced by the kind of condenser tube employed. Tests made at the Bureau of Standards with glass condensers have given after blank runs an amount of alkali in the distillate equivalent to 0.0001 to 0.0002 gram of nitrogen. The same solutions used in blank determinations with block tin condenser tubes have given only 0.000015 gram of nitrogen. The high blank with glass condensers is, however, quite constant and satisfactory duplicate results are obtained by carrying out two determinations on a given steel using a glass condenser for one and block tin for the other.

However, the correction for glass condensers is larger than is desirable when it is considered that the combined nitrogen found by this method in a 5-gram sample of steel lies between 0.0002 and 0.0007 gram.

Errors From Nessler Solution

A series of bessemer steels was analyzed for combined nitrogen and the ammonia determined by both the acid-alkali titration and by the Nessler colorimetric methods. Except in the case of the 0.1 per cent carbon steel, the Nessler method gave lower results than the titration method. The difference between the two values—i.e., the error in the Nessler determination—became greater the higher the carbon. Results of these analyses are shown in Table I.

TABLE I— OMPARISON OF TITRATION AND NESSLER METHODS

Bessemer Steel Samples

Approximate Per Cent Carbon	Per Cent Combined Nitrogen — Titration	Titration Average	Nessler	Nessler Average	Excess Titration Over Nessler
0.1	0.0133				
	0.0126		0.0132		
	0.0123	0.0127			
0.2	0.0105		0.0090		
	0.0107	0.0106	0.0097	0.0094	0.0012
0.4	0.0112		0.0100		
	0.0115	0.0114	0.0098	0.0099	0.0015
0.6	0.0094				
	0.0095	0.0095	0.0076		0.0019
0.8	0.0120				
	0.0117				
	0.0111				
	0.0117	0.0116	0.0093		0.0023

Many texts on the analysis of iron and steel give the Allen method with the Nessler solution, but these results indicate that in steels containing 0.2 per cent carbon or over titrimetric methods should be used.

Solution of Samples

Solution of the steel or iron is effected in a small covered beaker heated on a steam bath. A number of determinations were made in which the solution was carried out in a closed vessel and the evolved gases led through a bubble-tube containing hydrochloric acid, a procedure often recommended. Both portions of acid were then combined and the ammonia determined in the usual manner. No higher results for nitrogen were obtained than when the sample was dissolved in a beaker (Table II).

TABLE II—COMPARISON OF METHODS OF SOLUTION

Sample	Evolved Gases Not Washed in HCl. Per Cent Nitrogen	Evolved Gases Washed in HCl. Per Cent Nitrogen
Bessemer steel.....	0.0121	0.0123
	0.0125	0.0126
Electric arc weld-metal		
A- 8	0.135	0.132
A-10	0.122	0.119

Low results for nitrogen are, however, often obtained if solution is made in a beaker heated over a gas burner,

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[1] H. Braune, *Stahl und Eisen*, vol. 26, p. 1359 (1906).
[2] A. H. Allen, *J. Iron and Steel Inst.*, vol. 40, p. 181 (1880).
[3] H. Braune, *Chem. Centralblatt*, 1904, II, p. 1167.
[4] Boussingault, *Z. anal. Chem.*, vol. 1, pp. 112-4 (1862).
[5] Petren and Grabe, *Stahl und Eisen*, vol. 27, pp. 1700-1 (1907).
[6] T. Hurum and H. Fay, *Chem. & Met.*, vol. 26, pp. 218-22 (1922).
[7] N. Tschischewski, *J. Iron and Steel Inst.*, vol. 92, II, pp. 47-90 (1915).
[8] N. Tschischewski, *Stahl und Eisen*, vol. 28, I, p. 397 (1908).

on a hot plate, or on a sand bath instead of on the steam bath as described above.

Method Used by the Bureau[9]

It was at first thought necessary to prepare special ammonia-free hydrochloric acid for dissolving the sample, but it was later found that a fresh bottle of concentrated acid of the c.p. grade diluted with ammonia-free water to a sp.gr. 1.11 usually gave a sufficiently low blank determination. The sample of steel or iron 5 grams in weight (unless known to be very high in nitrogen[10]) is dissolved in 50 c.c. of this acid. While the solution is taking place, 30 c.c. of sodium hydroxide solution, prepared as directed by Blair and Langley,[11] one or two pieces of mossy zinc and 400 c.c. of distilled water are placed in the distilling apparatus. This distilling apparatus consists of a 1-liter Erlenmeyer flask connected with a condenser whose block-tin inner tube is bent downward at its upper end as shown in Fig. 1. The alkaline solution in the flask is then boiled until 200 c.c. has distilled over. This distillate is discarded, the contents of the distilling flask are permitted to cool slightly and the solution of the steel sample is introduced through a separatory funnel in the stopper of the distilling flask. The solution of the sample is not filtered. The beaker in which the solution of the sample took place and the separatory funnel are rinsed into the distillation flask with three 50 c.c. portions of ammonia-free water. The contents of the flask are then boiled until 200 c.c. of distillate is collected in 25 c.c. of 0.01 normal sulphuric acid. The adapter at the end of the condenser should dip into the acid or be connected with a receiver of a type which causes any escaping gas to bubble through it.

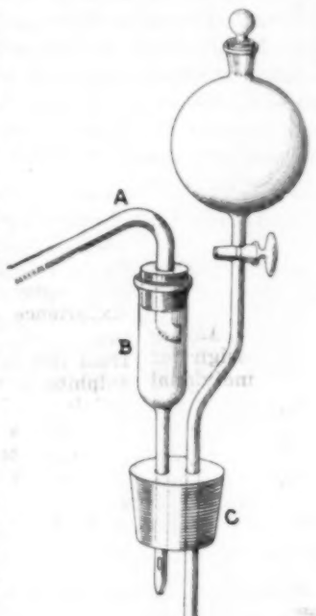

FIG. 1—DIAGRAM OF CONNECTIONS
A—Block tin tube.
B—Carbon filter funnel.
C—Flask stopper.

After distillation is complete, the excess of sulphuric acid is titrated with 0.01 normal sodium hydroxide, using as an indicator one drop of a 1 per cent aqueous solution of sodium alizarine sulphonate. The end point is the complete disappearance of the clear green color or the first indication of brown. This method of determining the ammonia in the distillate is much superior to the method involving the use of Nessler solution, and probably as convenient and accurate as the iodide-iodate method.

A review of the properties of some of the nitrides possibly present in the steel indicates that iron nitride is readily and completely decomposed by dilute acids with the formation of ammonia.[12] Aqueous acids and alkalis have little effect on silicon nitrides[13]; fusion with alkali is required to convert their nitrogen to ammonia. Manganese nitride is decomposed slowly by water and more readily by acids[14]; it is rapidly decomposed by hot caustic alkali solutions with the formation of ammonia. Aluminum nitride is completely decomposed by hot alkaline solutions.[15] Titanium nitride is insoluble in dilute acids but is decomposed in boiling potassium hydroxide solutions.[16]

Therefore, the nitrogen determined by the solution method is probably chiefly that present as iron and manganese nitrides. If the solution of the sample is not filtered before distillation, it is possible that nitrogen present as aluminum or titanium nitrides is also converted to ammonia by the boiling alkali solution during distillation. Nitrogen dissolved, adsorbed, or mechanically held in pores or blowholes will not figure in the result.

Removal of Sulphur From Illuminating Gas

The use of coals of the central coal-mining district for gas manufacture, owing to their relatively high sulphur content, makes the purification of gas for domestic and industrial uses an increasingly difficult problem. In fact, with the gradual exhaustion of the choice low-sulphur coal beds, gas purification is becoming generally more of a problem to the gas industry. Commercial hydrated oxide of iron, the commonly used purifying agent, varies widely in its quality as a gas purifier.

No completely satisfactory laboratory methods for the evaluation of oxides now exist. The Bureau of Mines is co-operating with the American Gas Association in the effort to perfect testing methods and to learn more concerning the effects of different chemical and physical conditions on the properties of hydrated iron oxide in use for gas purification. Among the conditions affecting the use of oxide studied during the present year are moisture temperature, iron content and sulphur content of oxides, and hydrogen sulphide content of the gas to be purified. A report covering the results of these studies is now in preparation.

American Fertilizers Popular in Italy

The use of chemical fertilizers in Sicily has shown a marked increase during the past few years, and American products of this class have always enjoyed a ready sale and a good reputation, according to a report to the Department of Commerce from Consul Nathan. Approximately 140,000 tons of sulphate of ammonia is consumed annually, of which 50 per cent is supplied by domestic manufacturers (north of Italy), and the remainder is imported from the United States, Great Britain and Canada.

Nearly 180,000 tons of superphosphates is used. Italian manufacturers, enjoying a large advantage in the matter of competition because of their close proximity to the sources of raw material at Tunis and Algiers, supply three-quarters of the total, and America, Belgium and Egypt supply most of the remainder.

The price of citrate of lime in Italy has been fixed for the seasons of 1922 and 1923 at 600 lire per 100 kilograms.

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[9] Essentially the Allen method with modifications, chiefly those by Tschischewski (See Note 7).

[10] For alloys containing 0.1 per cent nitrogen 2-gram samples are used. With still higher nitrogen content, as in nitrogenized iron, the acid solution of the metal is diluted with ammonia-free water to a known volume and aliquot samples are taken which contain nitrogen equivalent to not more than 25 c.c. of 0.01 normal acid.

[11] A solution of 300 grams of sodium hydroxide in 500 c.c. of water is digested at 50 deg. C. for 24 hours over a zinc-copper couple.

[12] G. J. Fowler, *J. Chem. Soc., Trans.*, vol. 79, pp. 285-99 (1901).

[13] L. Weiss and T. Engelhardt, *Z. anorg. Chem.*, vol. 65, pp. 38-104 (1909).

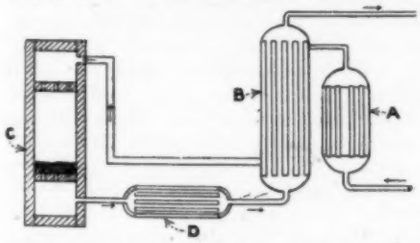
[14] G. C. Henderson and J. C. Galletly, *J. Soc. Chem. Ind.*, vol. 27, p. 387 (1908).

[15] S. A. Tucker and H. L. Read, *Trans. Am. Electrochem. Soc.*, vol. 22, pp. 57-65 (1912).

[16] O. Ruff and F. Eisner, *Ber. deuts. chem. Ges.*, vol. 41, p. 2252 (1908).

Recent Chemical & Metallurgical Patents

Production of Nitrogen Oxides From Ammonia by Catalysis—A cut is herewith reproduced, showing an apparatus in which this process is carried out. The ammonia-oxygen mixture passes through heat exchangers *A* and *B*, where the incoming gases are heated to approximately 200 deg. C. They then enter a reaction chamber of considerable size before the hot gases come in contact with the catalyst. This space is usually as much as a meter long. The contact mass in chamber *C* then oxidizes the mixture and the gases leave at a temperature approximately 750 deg. C.



They are cooled off in chamber *D* to about 400 deg. C., and then are used to heat the incoming gases in the first heat exchanger. The essential features of this process are, first, the use of the gases produced in the reaction to preheat the incoming gases, and second, the large capacity of the reaction chamlinings of the preheaters and reaction chambers are of such materials that they will not induce a premature catalytic action. Such metals as copper, iron and magnalium are avoided. The author seems to prefer non-metallic linings, such as fireclay, heavy magnesia and the like. The advantages of this apparatus are, first, the more complete oxidation, due to the elimination of inhibiting action before the catalyst is reached, and second, a very efficient use of the heat generated in the reaction. (1,426,952. Karl Bosch, of Ludmigshafen, Germany, assignor to the Badische Anilin und Soda Fabrik. Aug. 22, 1922.)

Apparatus for Washing Insoluble Powders—P. W. Prutzman, of Los Angeles, assignor to the General Petroleum Corporation of California, has developed a washer for insoluble powders which embodies the following principles: First, the powder is placed in a conical bottom tank and solvent is pumped up through the tank. Near the top of the tank is a screen, through which the solvent is permitted to go, but which in turn keeps back the particles of solid material. The solvent, after passing through the screen at the top of the tank, overflows and is pumped back into the tank again, entering at the bottom of the cone. Thus the solvent circulates upward through the powder to be washed. The solvent may be replaced by another portion of clean solvent, the old solvent being used in another similar washer on unwashed material. Finally, after successive portions of solvent have been used, the mass is dropped into a pulp tank, where it settles out. (1,426,099. Aug. 15, 1922.)

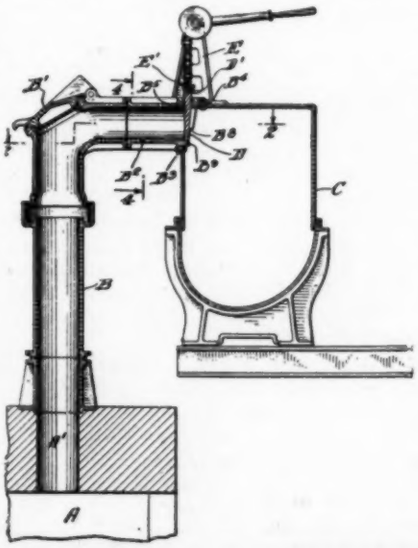
American Patents
Issued Nov. 21, 1922

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,435,930—Production of Sodium Sulphate.
1,436,094—Coke Oven.
1,436,095—Coke Oven.
1,436,096—Coke Oven.
1,436,097—Coke Oven.
1,436,098—Coke Oven.
1,436,164—Titanium Pigment.
1,436,179—Production of Cyanamid.
1,436,180—Converting Cyanamid to Urea.
1,436,196—Gas Purification system.
1,436,230—Separation of Magnesia From Lime.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Collecting Main for Coke Ovens—The invention shown in the accompanying drawing consists of a new design for a cut-off valve between an individual ascension pipe from a coke oven and a gas-collecting main serving a battery of ovens. This consists of a slide or damper valved as used on many types of ovens, but located to operate in a vertical plane instead of in a horizontal plane, as was formerly the practice. Due to the construction of this valve



and its seat, as shown in the drawing, it tends to cut away the deposits of hardened pitch and carbon which always form at this point, thus insuring the proper seating of the valve when it is hammered home. (1,433,634. Charles V. McIntire, assignor to Louis Wilputte and Alice A. Wilputte. Oct. 31, 1922.)

Improved Sulphite Pulp Process—A modified sulphite cooking liquid for which is claimed the advantages of producing a finer fiber and one which is capable of being easily bleached and easily hydrated and from which the waste liquor can be easily recovered is described in a specification taken out by George A. Richter, of Berlin, N. H., and assigned to the Brown Co. A cooking liquor is prepared by passing gaseous sulphur dioxide through a 3 to 5 per cent solution of sodium sulphate until the resulting acid solution contains free sulphurous acid from 2 to 7 per cent. The sodium sulphate is reduced by this treatment to sodium sulphite and sulphuric acid is formed. The inventor assumes that as the cooking progresses sodium sulphite is used up in neutralizing free organic acids formed by the hydrolysis of the cellulose. This unbalances the reversible reaction and brings about the formation of more sodium sulphite, which is in turn able to react with more free organic acids. Thus progressive decomposition continues until the cooking operation is complete. In this way the sodium sulphate present in solution acts as an available source of sodium, which may be transformed into an active constituent represented by sodium sulphite. Experience has demonstrated that the concentration of sulphuric acid resulting from this progressive supply of sodium sulphite is not sufficient to injure the cellulose fiber resulting from the cooking process.

The waste liquor from the process is collected in a suitable tank and is neutralized with sodium carbonate and is then evaporated and concentrated and then burned in an oxidizing atmosphere so that the sulphate is recovered in the same form in which it was previously used and is thus ready to be used again.

The advantages claimed for the process are that it is possible to produce a cooking liquor by passing the sulphur dioxide through a clear solution rather than through a milky suspension, thereby eliminating the trouble encountered in handling such suspensions; its advantage over calcium bisulphite liquor lies in the fact that any sulphate formed by the action of sulphur trioxide in the burner gas will not produce insoluble calcium sulphate. It is also claimed that the process produces a pulp of better color and greater strength than the average unbleached pulp by the calcium bisulphite process. The ease of recovery of the sulphate from the waste liquor is of course an added advantage. (1,427,125. Aug. 29, 1922.)

Desulphurizing Gas—A process which consists in first passing the gas through charcoal, then adding to it at least the required amount of oxygen for oxidizing the hydrogen sulphide and passing the mixture through active charcoal is patented by Alwin Mittasch and Max Schumann, of Badische Anilin und Soda Fabrik. (1,430,920. Oct. 3, 1922.)

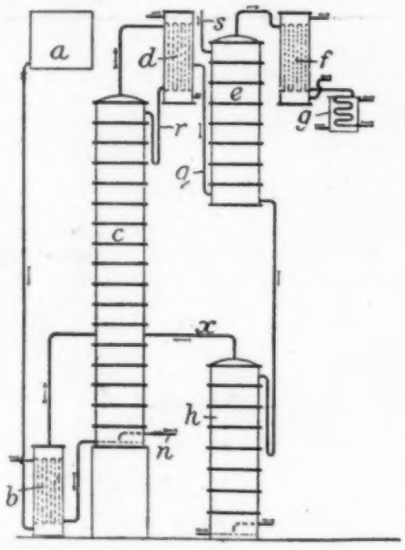
Complete Gasification Apparatus—Sir Arthur McDougall Duckham in this patent describes a complete gasification process which consists in a combined vertical retort and water-gas machine. Several of the retorts are superimposed on a single water-gas generator so that the coke is discharged directly from the retorts into the water-gas generating space. The retort is heated externally during the blow period by the blast gases and during the gas-making period by burning a small portion of the water gas in the heating flues around the retort. The remainder of the water gas made passes through the coal which is being coked, also contributing to the heat for carbonization. (1,428,421. Arthur McDougall Duckham, London, England. Sept. 5, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Inks and Paints—Inks and other pigmenting and like compositions for printing, duplicating, etc., comprise as the vehicle for the coloring matter an emulsion or emulsoid in the form of a plastic solid, of which the yield value (defined as the finite pressure it is necessary to apply before any flow through a capillary orifice takes place) is materially greater for the emulsion than for its components, the yield value of the components being, for example, zero. The composition may have the property of breaking down when brought into contact with paper or other porous material, one of the components being absorbed thereby. One of the components may be an oleaginous material, such as Yorkshire grease, wool fat, wool wax or adeps lanæ, a wax such as Japan wax or beeswax, or a soap insoluble in water, and the other component may be water, the components being emulsified with or without the use of emulsifying agents. The water forms the internal phase, and preferably acts as the sole solvent for the coloring material, which must be of such a nature as not to break down the emulsion or reverse the relationship of the phases. Pigments such as graphite, which are selectively wetted by the external phase, may also be used. The oleaginous material may be mixed with a thinning agent. A thickening agent such as gum or starch may be dissolved in the water, but the addition of a substance to delay evaporation is unnecessary. A salt of a polyvalent metal may also be added. Three examples are given, as follows: (1) Yorkshire grease is dissolved in a light mineral oil and the solution incorporated with a 10 per cent solution of nigrosine in water; (2) aluminum stearate is treated with a light mineral oil and emulsified with a 5 per cent solution of nigrosine in water; (3) a mixture of turkey red oil, glycerine, and castor oil, with a pigment such as graphite, lamp-black or hydrated alumina, is emulsified with water. (Br. Pat. 183,513. A. de Waele, London. Sept. 20, 1922.)

Dehydrating Alcohol—In preparing alcohol of 98 to 99 per cent strength, alcohol vapors are brought into contact with glycerine, which acts as a dehydrating agent. The glycerine preferably flows down a rectifying column up which alcohol vapors are passed. In a continuous apparatus, alcohol of 92 to 93 per cent strength passes from a tank *a* through a preheater *b* to a column *c* heated by steam injected through a pipe *n*. The vapors from the top of the column are partly condensed in a condenser *d*, the liquid condensate from which is returned by a pipe *r* to the column *c*. The uncondensed vapors pass by a pipe *q* to the base of a column *e*, down which glycerine admitted by a pipe *s* passes. The vapors pass from the top of the column to condensers *f*, *g*. Glycerine passes from the base of the column *e* to a column *h*, in which it is treated



with steam to remove alcohol, which is passed as vapor by a pipe *x* to the column *c*. The glycerine is finally treated to separate water and used again. A second specification, 184,129, covers the use of an anhydrous or hygroscopic salt such as calcium chloride, zinc chloride or potassium carbonate as the dehydrating agent. (Br. Pat. 184,036. J. van Ruymbeke, Marseilles, Sept. 27, 1922.)

Fatty Acid Esters—Organic acids, other than polyoxy fatty acids, are converted into esters by the aid of zinc, tin or other metal of the periodic group of which tin is a member. Particular reference is made to the esterification of fatty and resin acids. Fats containing free fatty acids can be neutralized by heating at ordinary or reduced pressure in the presence of tin with the necessary quantity of glycerol or of the mono- or di-glycerides of such acids as caprylic, lauric, myristic, stearic, oleic or erucic acid. According to the example, a mixture of copra oil waste and copra fat acids is heated with glycerine in the presence of tin until the acid value of the fats becomes practically nil, the reaction taking place with exclusion of air first at normal pressure and then under reduced pressure. (Br. Pat. 183,897. P. Haddan, London. Sept. 27, 1922.)

Viscose—To avoid the necessity for the ripening process in the manufacture of viscose and to obtain directly a high molecular product, cellulose, or a near conversion product of cellulose, associated with caustic alkali in a concentration of 15 per cent and upward, preferably 20 to 50 per cent, and in a quantity of not more than two molecules of caustic alkali, preferably one molecule or less, per molecule of cellulose, is treated with carbon bisulphide in a quantity of not more than one-half molecule—for example, one-fifth to one-half molecule—per molecule of cellulose. The treatment with the reduced proportion of carbon bisulphide is conveniently carried out in the presence of benzol or other solvent or diluent for carbon bisulphide. In an example, cellulose is treated with a 20 to 50 per cent caustic soda solution, and the surplus liquid separated so as to leave one molecule of caustic soda to one molecule of cellulose; either immediately or after standing, one-half to one-quarter molecule of carbon bisulphide diluted with benzol is added, and the mixture kneaded; the diluent is eventually separated by evaporation *in vacuo* or by the addition of water. The viscose is soluble in water or in alkali, and may be spun without ripening. When used for the spinning of artificial silk or in the manufacture of films, etc., the following coagulating baths may be employed—bisulphates or mineral acids, or weaker acids such as acetic or formic acids, or stronger acids such as oxalic acid alone or together with such weaker acids, or alkali bicarbonates; in the case of these weaker acids or alkali bicarbonate baths, the temperature of these is preferably raised to 30 to 40 deg. C. (Br. Pat. 183,882. H. Dreyfus, London. Sept. 27, 1922.)

Tungsten—Tungsten powder suitable for the production of lamp filaments is obtained by reducing (in hydrogen) materials called "complex tungstic acid." The materials mentioned are compounds of tungstic acid with silicic and boric acid respectively and are prepared by boiling sodium tungstate with water glass and acetic acid or with silicic acid or boiling tungstic acid and ammonia with silicic acid; or by boiling sodium tungstate with boric acid. In each case the treatment is continued until strong hydrochloric acid does not precipitate tungstic acid. The reaction mixture is in some cases poured into strong hydrochloric acid and an oily layer is separated from which the complex tungsten acid is crystallized. Specification 155,851 is referred to. (Br. Pat. 183,816; not yet accepted. Naamlooze Vennootschap Philips' Gloeilampenfabrieken, Eindhoven, Holland. Sept. 20, 1922.)

Synopsis of Recent Chemical & Metallurgical Literature

Investigation of Soil Absorption

As a rule, considerably less than 5 per cent of the absorptive capacity of a soil is in the unaltered mineral particles, and 95 per cent or more is due to what is known as the colloidal material, says the U. S. Department of Agriculture in a professional paper, "Absorption by Colloidal and Non-collodial Soil Constituents," recently published as Department Bulletin 1,122.

The results given in the bulletin are at variance with some of the older but still prevalent conceptions regarding soil absorption. According to the old notion, the more highly absorptive soils were supposed to contain some specially absorptive mineral called zeolites, but it is now very generally recognized that if definite crystalline zeolites are present at all they are there in extremely small amounts. It was also thought that aside from the absorption caused by organic matter, most of the absorptive capacity was due to the fineness of the mineral particles, and not to the relative amount of surface exposed by these particles. It is now coming to be realized that the highly absorptive inorganic material is not crystalline zeolites but amorphous material such as iron hydroxide, aluminum hydroxide, silicic acid and aluminum silicate gels. The investigations tend to confirm the more modern view of soil absorption and give for the first time an estimate of the amount of absorption due to the colloidal material and to the non-colloidal particles.

Ethyl Chloride in Refrigeration

That ethyl chloride is a very convenient material for commercial refrigeration is the conclusion one draws from a paper by Prof. C. F. Jenkin recently presented before the British Coal Storage and Ice Association. Commenting on this paper in its issue of Oct. 21, 1922, *The Chemical Age* (London) lists the various advantages of ethyl chloride, among which are the following:

It did not attack metals, but it did contaminate mercury. It attacked india rubber, but vulcanized rubber tubing and corks could be used, though they leaked a little. They swelled considerably, but returned to their original size when the ethyl chloride dried off. Pure rubber tape was softened almost to solution. Vulcanite swelled moderately. It caused most woods to swell, but lignum vitæ could be used for valves, etc., when a non-conductor of heat was required. Bakelite was also useful as a non-conductor; it swelled only very slightly.

Liquid ethyl chloride dissolved a small quantity of water, but could be dried by passing it through calcium chloride drying tubes. With water it formed very remarkable ice crystals. Similar crystals formed at the throttle valve in a refrigerating machine if there was any water dissolved in the ethyl chloride, and quickly choked the valve. Ethyl chloride was also a convenient cooling material for use in laboratories; when sprayed on to any object, the temperature is quickly reduced to —20 deg. C. or lower.

For mechanical refrigeration ethyl chloride was very suitable. The vapor compression cycle was the one used. The pressures corresponding to the ranges of temperature commonly required were very low—for example, for a range of ±20 deg. C., the pressures were 19.4 and 3.5 lb. per sq.in. absolute. The type of compressor generally used was a rotary pump. To avoid air leaks all valve spindles, compressor shafts, etc., had to be sealed with glycerine, so that any leakage was of glycerine.

The flammability of ethyl chloride was its most serious drawback. To get over this, various "non-flam ethyl chlorides" had been put on the market in Great Britain. These were mixtures of ethyl chloride with large proportions of ethyl bromide. The mixture was not only non-flammable but could be used as a fire extinguisher. Its properties as a refrigerator were not very different from those of ethyl chloride, but as it was heavier than glycerine special separators were necessary.

Book Reviews

JOURNAL OF THE IRON AND STEEL INSTITUTE, 1922, No. 1. (Volume No. 105). Edited by *George C. Lloyd*, Secretary. Published by the Institute, 28 Victoria St., London, S. W. 1, England. (American Agents: Spon & Chamberlain, 123 Liberty St., N. Y. City.) Price, $9.50.

A great variety of papers is contained in this, as in all recent volumes of the *Journal* of the British Iron and Steel Institute, ranging from the operation of a blast furnace to X-ray studies of crystal structure. Perhaps half the volume could be classed as "practical," the other half as "theoretical."

Blast-furnace practice was discussed in its broad commercial aspects by the president, Francis Samuelson, in his address. D. E. Roberts also presented details of various methods of getting ore, coke and flux from the stockyard to the top of the blast-furnace shaft in a paper entitled "Notes on Blast-Furnace Filling." Another voluminous paper, "Recent Developments in Power Production," excited a deal of discussion, as did also a study of "British Siemens Furnace Practice," by Fred Clemens. The latter comprised a thorough analysis of the operations of a new 60-ton open-hearth furnace; all the observed data are included on log sheets, and the derived conclusions should undoubtedly be studied by all furnace superintendents and designers.

Reactions between gases and the constituents of steel are discussed in three papers by Carpenter and Elam, Austin, and Ehn. The latter restated his views on the influence of dissolved oxides on carburizing and hardening qualities of steel. Several members, while admitting that Ehn had discovered a connection between microstructure and defective carburizing properties, doubted that he had proved trat the trouble was due to dissolved oxides. On the other hand, Portevin was able to duplicate Ehn's "abnormal structures" when carburizing overblown bessemer steel.

Microscopical and thermal studies of austenite and its decomposition products were presented by Hallimond, Honda and Kikuta, Yamada, Belaiew and Whiteley—forming in all a mass of extremely interesting metallographical data on hardened and annealed steel. Westgren and Phragmén also presented a contribution on "X-Ray Studies on the Crystal Structure of Steel." In view of the opinion Dr. Westgren presented in *Chem. & Met.*, vol. 25, p. 641, when discussing the "Slip Interference Theory of Hardening," it is interesting to observe that he now presents evidence to show that martensite has the crystallographic structure expected of extremely minute crystals of alpha iron. He thinks these crystals are of the order of 20 A.u. in diameter, containing only a few hundred atoms, and are on the verge of being totally amorphous. Furthermore, the cubic lattice of both gamma and alpha iron is slightly distended by the carbon in austenite and martensite in a way to suggest that carbon is uniformly distributed as atoms in both constituents. Cementite has also been found to crystallize in the orthorhombic system.

About 150 pages at the end of the book are devoted to notes on current literature. Perhaps 750 references are noted—many of them of course are quite perfunctory, but on the other hand, excellent digests of many important papers can be noted on even a hurried examination. E. E. THUM.

A HANDBOOK FOR ELECTROTYPERS. By *John F. Locke*. 35 pp. Published by the author, Cincinnati, 1922. Price, $1.

The introduction states that this booklet served as a basis for a series of lectures to electrotypers. There is today a large field for the application of the principles of science in both the electroplating and electrotyping industries, and the author is to be commended for his efforts in this direction. It is unfortunate, however, that, perhaps through the desire for simplification, he has made several misleading or inaccurate statements, such as the following: "The internal resistance [of a bath] is reduced by . . . a lowering of the temperature." "The higher its conductivity [of an acid copper bath] the lower the *amount of current* needed." "Boric acid is being used [in a nickel solution] to increase the conductivity of the bath." The presence of these and other errors reduces greatly the value of the book to those who are in need of an accurate presentation of scientific facts and theories in simple language.

WILLIAM BLUM.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

War Department Appoints Chemical Advisory Board

Asks Co-operation of Prominent Representatives of Industry as Aid in Carrying Out National Defense Act

The Assistant Secretary of War, J. M. Wainwright, has addressed a letter to twenty-two prominent representatives of the chemical industry and of technical educational institutions requesting their individual co-operation in an advisory capacity in matters pertaining to the chemical industry which present problems difficult of solution by the layman. The letter points out the desirability of co-operation between the War Department and the industrial interests of the country in preparing for the future defense needs of the nation in carrying out the provisions of the national defense act.

Desirability of Co-operation

The letter is reproduced below:

In carrying out the provisions of the national defense act, with respect to the question of preparation for mobilization of national industries in time of war, I very often find myself confronted with matters regarding the broad field of chemical industry difficult of solution by laymen.

I have conceived the idea of asking fifteen or twenty gentlemen connected with the various activities of the chemical field (industrial, academic and research) to co-operate with me in such matters, assuming that they ought to know what the War Department is doing, or would be interested to the extent of assisting in an advisory capacity.

You, of course, will realize that in carrying out the provisions of the national defense act in the way of preparation for the future defense needs of the nation, there should be co-operation between the War Department and the industrial interests of the country, and I trust that you may see your way clear to permit me to call upon you for advice when the occasion demands.

The representatives of the industries, educational institutions, associations and publications who have been asked to serve on the advisory committee are as follows:

Prominent Men on Advisory Committee

Edgar F. Smith, president American Chemical Society; Henry Howard, vice-president of the Grasselli Chemical Co.; Edward W. Washburn, chairman, division of chemistry and chemical technology of the National Research Council; R. A. Milliken, research professor of physics, California Institute of Technology; V. C. Vaughan, National Research Council; Julius Stieglitz, professor of chemistry, University of Chicago; S. W. Wilder, Synthetic Organic Chemical Manufacturers' Association; C. L. Reese, chemical director, E. I. du Pont de Nemours & Co.; C. P. Townsend, Union Carbide & Carbon Corporation; J. George Lehman, vice-president, Bethlehem Foundry & Machine Co.; H. N. Ott, president, Spencer Lens Co.; John E. Teeple, consulting chemist; M. C. Whitaker, vice-president, U. S. Industrial Alcohol Co.; H. C. Parmelee, editor, *Chem. & Met.;* C. S. Miner, consulting chemist; Charles H. Herty, president, Synthetic Organic Chemical Manufacturers' Association; A. B. Lamb, professor of chemistry, Harvard University; Charles A. Meade, E. I. du Pont de Nemours & Co.; F. G. Cottrell, Nitrogen Research Laboratory; Charles L. Parsons, secretary, American Chemical Society; H. E. Howe, editor, *Journal of Industrial & Engineering Chemistry;* R. B. Moore, chief chemist, U. S. Bureau of Mines.

Engineering Council to Consider Important National Problems

A number of important problems of national as well as technical interest will be considered by the American Engineering Council, the executive body of the Federated American Engineering Societies, at its meetings in Washington, Jan. 11 and 12, 1923. The 12-hour day in industry, topographic mapping, government reorganization, types of government contracts and a wide range of other engineering, political and economic topics will be discussed. The plan for an engineering investigation into the Muscle Shoals situation will also receive consideration.

Tear Gas Effective for Dispelling Mobs

A highly effective method of spraying tear gas has been developed by the Chemical Warfare Service. The new device recently was tried out before police officials in Washington and was so effective that the observers, supposedly at a safe distance, inadvertently went through the experience of receiving a very thorough application of the gas. The representatives of the Police Department are very ready to testify as to its effectiveness in controlling mobs or rioters.

Sugar Refiners Protest Tariff Rate

Extensive Investigations Will Be Necessary to Bring Tariff Commission Data Up to Date

Acting under the flexible section of the new tariff act, an application for a reduction in the duty on sugar has been filed with the Tariff Commission in the name of the United States Sugar Association, an organization said to include in its membership a number of independent refiners in this country who have interests in Cuba. Cuban sugar interests are raising a fund of $70,000 to assist the effort to reduce the duty.

The application was filed by Edward Schoenech, of the law firm of Bond, Schoenech & King of Syracuse, N. Y., as attorneys for the United States Sugar Association, of which H. S. Rubino, of New York, is executive chairman and counsel.

While no specific reduction is asked, the application is understood to set forth that the duty fixed by the new tariff act is fully 1 cent per pound more than is necessary to equalize the differences in costs of production of sugar in the United States and Cuba. The flexible tariff section authorizes the President, after investigation by the Tariff Commission, to change rates of duty not more than 50 per cent to equalize costs of production.

The sugar duty in the new tariff is 2.20 cents per pound, and as Cuba enjoys a 20 per cent preferential on imports into the United States, the effective duty on Cuban sugar is 1.76 cents per pound. Under the emergency tariff, which the 1922 tariff act supplanted, the general duty on sugar was 2 cents per pound, with 1.60 cents per pound on Cuban sugar.

Investigations Necessary

As the data of the Tariff Commission regarding sugar are out of date, considerable preliminary investigation will be necessary before this application is reported to it for action. It probably will be necessary to send an agent to Cuba, and possibly elsewhere abroad, before a report can be compiled. It is not probable that there will be any definite action regarding this petition for several months, and even then the commission might decide that there had been no change in conditions since enactment of the tariff bill with its rates expressing the will of Congress which would justify an investigation.

Students Keep Busy During Vacation

Chemical Engineering Students at University of Michigan Establish Record for Industry During Summer

Statistics compiled by the department of chemical engineering at the University of Michigan show that the policy of encouraging undergraduates to obtain summer employment is approved by the students. Tabulations representing a digest of the survey of summer employment of the present junior and senior classes of chemical engineers at the university show that outside of those who attended summer school, 94 per cent obtained employment of some nature. Of the eighty men who obtained employment, 11 per cent worked in industrial laboratories, 35 per cent engaged in plant work outside of the laboratories, and the remainder obtained employment of a miscellaneous nature.

The university points to this record with pride, as proving a spirit of industry and earnestness on the part of the students and indicating that a great majority of them are paying at least a portion of their college expenses. It is also interesting to note that there appears to be no difficulty for a student to obtain useful employment during the summer months.

Variety of Occupations

A great variety of occupations are represented by the report of the seniors, ranging from specialized engineering work in chemical plants to common laborers and railroad ticket agents. Among the different types of laboratories represented in the report are highway laboratories, dye works laboratories, locomotive works laboratories and automobile plant laboratories. The industries which furnished employment to the students include gas plants, automobile plants, food product plants, metallurgical plants, foundries, telephone companies, alkali plants, condensed milk plants, boiler plants and oil companies.

Not only does this report speak well for the co-operative spirit of the undergraduate but it shows that such efforts by educational institutions will have the support of industrial establishments. Among the names of the companies co-operating to the extent of giving summer employment to these undergraduates are dozens of well-known manufacturers of highly specialized technical products.

Seek Substitute for Carbon Bisulphide as Grain Fumigant

The use of carbon bisulphide as a fumigant of grain has been discontinued by the railroads of the country, except at certain points, particularly Baltimore and New Orleans. The Department of Agriculture is working on a series of tests looking to the development of a more suitable fumigant for grain.

May Distribute Byproduct Gas for Industrial Fuel

The proposed developments by the Alabama Byproducts Co., operating a large coking plant near Birmingham, to lay a pipe line through which byproduct gas could be transported to a number of industrial plants in the eastern section of the city is being watched with interest by the other operators of similar plants in the district. The city commission of Birmingham has been requested to grant a permit for the construction of this pipe line, and it is thought it will grant the request as soon as it has made an investigation.

Every byproduct plant in the Birmingham district is located near an active industrial section. Should the Alabama Byproducts Co. be permitted to lay the gas main to serve industrial plants, it would establish a precedent and make the path clear for the other companies to do likewise.

It is proposed to lay a 12-in. main from the plant to the East Birmingham section, a distance of about 2 miles, along the streets of Birmingham and the roads of Jefferson County. The gas is to be furnished to the Stockham Pipe & Fittings Co. and several other industries. The gas will not be purified and will not be connected with the mains of the Birmingham Railway, Light & Power Co., which takes gas from the Sloss-Sheffield Co. for public service distribution.

Morris W. Bush, president of the company, stated that the gas would be furnished to industrial plants only, and would be furnished them only when a surplus is available.

Progress Made in Reduction of Varieties of Fertilizers

Meetings of fertilizer salesmen with the state agronomists to agree on a policy of pushing a reduced number of high-analysis grades of mixed fertilizers are being arranged in the five states which recently reached an agreement with manufacturers of the Middle West to reduce from fifty-seven to fifteen the analyses being offered for sale in those sections.

Each state, through its authorized soils representatives, is selecting from the list of fifteen the special high-analysis fertilizers best suited to the varying conditions within its own borders. Ohio has selected twelve and Missouri ten. The selection will be explained to the salesmen, with the uses for which each analysis is best suited. The meeting in Ohio has been held, and those in Indiana, Minnesota, Michigan and Missouri, the other states represented in the agreement, will be held soon.

The soil improvement committee of the National Fertilizer Association is preparing stickers and other forms of advertising to make known the selected list for each state, giving the analyses selected by the college station of each state with the proper use for each major crop.

To Investigate Scarcity of White Arsenic

Cotton-Belt Congressmen Ask Action to Insure Farmers Supply of Insecticide

Aroused by complaints of constituents that the price of calcium arsenate has advanced rapidly and that the supply is short at any price, members of Congress from the cotton belt, where the compound has proved to be the most effective insecticide for combating the ravages of the boll weevil, are attempting to launch an investigation.

Two Resolutions Presented

Senator Harris of Georgia has written both the Department of Justice and the Federal Trade Commission asking them to investigate whether there exists a combination to control the price of white arsenic, the base of the insecticide. Representative Wise of the same state has introduced a resolution in the House directing the Federal Trade Commission to report the cost of manufacturing and producing calcium arsenate and whether the production and prices are controlled by any unlawful combination. Senator Smith of South Carolina has drawn a Senate resolution declaring that a crisis exists for agriculture because of the difficulty of obtaining arsenical insecticides and directing the Department of Agriculture, through the Bureau of Entomology, and the Department of the Interior, through the Geological Survey, to investigate the supply of white arsenic and possible development of new sources of supply.

The Secretary of Agriculture has reported informally that the production of white arsenic in the United States last year was below normal and that reports indicate that Australia has contracted for much of the Canadian supply.

There is no tariff duty on white arsenic, this chemical having been continued on the free list at the insistence of Southern Senators.

Georgia Buys Arsenic

The State of Georgia has taken the matter of combating the boll weevil in its own hands and has taken steps to obtain such supplies of calcium arsenate as may be necessary to cover the cotton acreage of the state in the coming season. Negotiations are under way between the Georgia State Department of Agriculture and the Salt Lake Insecticide Co. for these supplies. It is said that the state is planning to take the entire output of this company on contract during the coming season.

Some authorities have been counting on this new production to prevent an extremely high price for calcium arsenate in the spring, but if the entire production is taken out of the market by the State of Georgia alone, there is little chance that prices of calcium arsenate will be depressed to any extent by this production.

Management Problems Before Taylor Society

Papers on Application of Scientific Control to Various Industries Are Read at the Annual Fall Meeting

On Nov. 23 and 24 the Taylor Society held its annual fall meeting in the rooms of the Federated American Engineering Societies, New York City.

The annual business meeting was held on Nov. 22, in connection with an informal dinner at the Café Boulevard. In addition to the election of officers, plans were outlined at this meeting for the work of the society during the ensuing year, including the promotion of the use of budgets for control of sales and production.

The technical meetings occupied two daily and one evening session on Nov. 23 and 24. These meetings covered very thoroughly the application of scientific management and control to various industries, showing how the industry should be organized, how the data should be obtained and how the budgets made up from these data could be applied to effective operation of the industry. Examples were drawn from effective industries such as the Corona Typewriter Co., the Lewis Manufacturing Co., the Joseph & Feiss Co., Day & Zimmerman, Inc., the Hood Rubber Co., the Dennison Manufacturing Co., the United States Rubber Co., the Union Carbide Co., and the Tidewater Oil Co.

The following topics were covered in developing the scheme of the program: The organization and the management of a medium sized plant; statistical compilation and its uses; shaping management to meet developing industrial conditions; master budgets of sales and production; reduction of waste, and the supervision of personnel.

Sales Problem of the Future

The paper on "Shaping Management to Meet Developing Industrial Conditions," given by H. S. Person, managing director of the Taylor Society, was particularly noteworthy. Mr. Person pointed out that the market before industry today and probably for the next decade is a buyers' market. Under this condition the sales problem will be the most critical problem which industry must meet. In the solution of this problem two important phases will stand out: First, the market must be thoroughly analyzed and second, precise co-ordinated schedules of sales, production and finance must be made on the basis of this analysis. After these two phases of the problem have been satisfied, the most complete co-operation within the organization will permit successful operation.

To Study U. S. Potash Plants

The Bureau of Mines has assigned Dr. Andrew Stewart to the work of making a survey of the present conditions of the 88 potash permits outstanding. Dr. Stewart has been studying potash production in this country and its possibilities.

Expect Bill to Authorize Crediting of Reparation Dyes to Army Expense

A joint resolution will be presented in Congress in the near future authorizing acceptance of German dyes and chemicals from the Reparations Commission to be charged against the bill of the United States for maintaining troops on the Rhine, and setting up an agency to distribute these products, according to report in Washington.

The resolution probably will limit the quantity which may be accepted for this purpose and also throw further limitations about the action which will protect domestic producers of chemicals and dyestuffs.

The State Department has retained F. S. Dickson, who was chief of the Dye and Chemical Control Board established to operate the dye licensing system, or embargo, as its adviser in handling this question of reparation dyes.

Dye Strength Regulations

The Treasury Department has under advisement the issuance of temporary regulations for the importation of coal-tar products pending determination of questions of comparability and standard strengths toward which a board is now working. Dye importers have pointed out that until these questions are determined there is danger of confiscation under the new tariff act through erroneous declarations of value and have urged that temporary arrangements be made.

The State Department is considering three plans for the handling of reparation dyes. Each of the plans under consideration contemplates the formation of a board or a commission to be representative of manufacturers, importers and consumers of dyes.

One of the plans contemplates the setting up of this board as a part of the State Department to distribute the dyes. Another would make the board, or commission, independent of the State Department, to which the department would assign its equity in these dyes. Still another plan is that the State Department sell outright to the board, or commission, the dyes allotted to this country.

It is believed that one of these plans will be used as a basis for a draft of a joint resolution which will be submitted to Congress as soon as the necessary consideration has been given the proposals.

Washington and Baltimore Chemists Visit Sugar Refinery

On Nov. 24 about forty Washington chemists joined an equal number from Baltimore and visited the Baltimore plant of the American Sugar Refining Co. This largest and most up-to-date sugar refinery of the world was explained in detail by special guides. At a meeting the same evening an address on the economics and the engineering problems of sugar refining was given by C. L. Huettinger, superintendent and chief engineer of the plant.

Nobel Chemistry Prizes for Soddy and Aston

Two British Physical Chemists Awarded Prizes for Most Important Work in Chemistry During 1921 and 1922

The Nobel chemical prizes for 1921 and 1922 have been awarded to Prof. Frederick Soddy of Oxford, and Dr. F. W. Aston of Trinity College, Cambridge. The Nobel prizes, which are probably the best-known honorary awards for scientific achievements, were founded by A. B. Nobel, the Swedish inventor of dynamite, for the encouragement of men and women who work for the interests of humanity. They are awarded annually for the most important work during the year in physics, chemistry, medicine, physiology, idealistic literature and service in the interest of peace. The prizes average $40,000 each.

Professor Soddy's Activities

Curiously enough, the two recipients were born within a day of each other, Dr. Aston on Sept. 1, 1877, and Professor Soddy on Sept. 2 of the same year, and both have studied under Sir Ernest Rutherford. Professor Soddy, whose name is particularly associated with the study of radio-activity, was educated at Eastbourne College, University College of Wales, and Merton, Oxford. In 1900 he was appointed demonstrator in chemistry at McGill University, Montreal. He was appointed lecturer in physical chemistry and radio-activity at the University of Glasgow in 1904, a post which he retained until 1913, when he left to take up the professorship of chemistry at Aberdeen University. In 1919 he was appointed Lee's professor of inorganic and physical chemistry at Oxford. Among his other distinctions, Professor Soddy has been president of the Röntgen Society and was the recipient of the Cannizzaro prize (Rome) in 1913. He was made a foreign member of the Swedish Academy of Sciences in 1919. He is the author of numerous scientific publications, chiefly on radio-activity, some of his works being "The Interpretation of Radium," "Chemistry of the Radio-Elements," and "Science and Life."

Aston Holds Many Honors

Dr. Francis William Aston's work on electric discharge in gases, mass spectra, isotopes and other physical and chemical subjects is well known. He was educated at Malvern College, Mason College, Birmingham University and Cambridge University. In 1909 he was appointed assistant lecturer in physics at Birmingham University. The following year he entered Trinity College, Cambridge, and studied under Sir J. J. Thomson and Sir Ernest Rutherford at the Cavendish Laboratory. He was awarded the MacKenzie Davidson medal of the Röntgen Society in 1920, and has been secretary of the Cambridge Philosophical Society since 1920. He was recently elected a Fellow of the Royal Society.

Manufacturers Collect Data on Refractory Brick

Questionnaires to Be Sent to All Users of Refractory Brick to Summarize Properties Demanded in Practice

An industrial survey which has for its purpose the uncovering of a mass of information with regard to the furnace conditions which refractory brick must meet in actual service will be conducted by the Refractories Manufacturers' Association in co-operation with committees which have already been appointed in associations of users of refractory brick and with individuals, firms and corporations to whom refractory brick is an industrial necessity. Up to the present, research in refractories, particularly in connection with the manufacture of refractory brick, has been largely confined to laboratory work.

This survey will consume the better part of 2 years and it is hoped that preliminary reports will be made at the end of the first 3 months, the first half year and so on, until the survey is completed. These reports will cover the information which will be gathered by using a rather elaborate questionnaire which will be distributed to consumers of refractory brick in the thirteen industries to which the bulk of this material goes. These include blast furnaces, stoves and connections; open-hearth furnaces and metal mixers; heating, puddling and forge furnaces; cupolas; malleable furnaces; oil refineries; gas plants; glass houses; by-product coke ovens; zinc, copper and lead refineries; boilers; cement, lime and plaster kilns, and kilns for burning ceramic products.

The questionnaire covers temperature and combustion conditions found in the typical furnace, abrasion, slag action, the presence or absence of uncommon furnace gases, spalling conditions, loads, insulation, character of draft, etc. This information will be sought in the industries named and the answers to the questionnaires will be sent to the Mellon Institute of Industrial Research, at Pittsburgh.

When enough information has been received to warrant the issue of a progress report in any single industry, this report will at once be made; it will include a statement of the more general and possibly typical conditions, with data relative to conditions which would properly be considered exceptional in that industry. Meager as these progress reports may be, they will be an important addition to present knowledge.

Conditions Rapidly Changing

Attention has been called to the rapidly changing conditions in many industries, caused by the necessity of obtaining greater production from each unit. To meet these conditions, brick of entirely different characteristics have been developed. In a great many cases no attempt has been made to co-ordinate the changes in requirements with the changes in the refractory material. This has resulted, in many cases, in the use of refractories which, while seemingly well suited for the purpose, did not and could not live up to their reputation. A study of furnace conditions often develops the cause of the trouble; so it is thought that a similar study will develop these conditions in advance of expensive failures.

Every consumer of refractory brick will derive a certain benefit from the successful prosecution of the work described. Wastes will be eliminated, which cannot help but reduce production costs. Intelligent service will follow authentic knowledge of requirements. The whole movement augurs well for the industry which is launching it and for every industry which finds refractory brick a necessary part of its plant equipment.

War Department Offers Sodium Nitrate for Sale

The War Department has called for bids on 25,000 tons of sodium nitrate, stored at Jacksonville, Tenn. Sealed bids will be received at the New York office of the Ordnance Salvage Board, Army Building, 39 Whitehall St., New York, until noon, Dec. 15. The material is offered in lots of 100 tons or more. It is packed in bags.

Week of Practical Instruction in Water Purification Planned in Texas

Arrangements are being completed for a short course of practical instruction for water and filtration plant operators at Dallas, Tex., during the week of Jan. 15, at which time the opening of the new White Rock filtration plant will be celebrated. The course will be under the joint direction of the State Health Department and the Dallas Health Bureau. Such subjects as storing, purification and distribution of water will be discussed by authorities on the topics during the course, and one day will be given over to a complete inspection of the White Rock plant. W. T. Davidson, director of public health, Dallas, will preside at the different sessions. The speakers will include Helman Rosenthal, chemist in charge of the Turtle Creek filtration plant; Robert T. Hill, geologist; C. M. Adams, city chemist and sanitarian; Major W. J. Powell, engineer to the supervisor of public utilities; John W. Everman, supervisor of public utilities; and David Morey, engineer in charge of construction of the White Rock filtration plant.

Personal

H. L. Blackmer has been elected chairman of the board of the Midwest Refining Co., Denver, Colo., manufacturers of refined petroleum products. T. A. Dines, senior vice-president, has been elected president.

Eversley Childs, formerly head of The Barrett Co., has resigned from the Allied Chemical & Dye Corporation and has been succeeded by Charles Robinson Smith, who was long an attorney for and vice-president of the General Chemical Co. Clinton S. Lutgens has been made vice-president of the corporation. Mr. Casey, formerly of the General Chemical office staff, has been made treasurer and Mr. Crisp has been made secretary. J. M. Weiss and C. R. Downs, lately honored by the Franklin Institute for their achievements in research, more particularly for the catalytic oxidation of benzene, and long connected with The Barrett Co., have also resigned.

Albert A. Heimrod, formerly with the Research Corporation, has been appointed chief engineer for the Federal Phosphorus Co. and other Swann interests in Alabama.

P. M. McHugh, of the Dorr Co., has gone to Hawaii on a business trip. He expects to be gone about 6 weeks.

Bernard L. McNulty has been elected president of the Marblehead Lime Co., Chicago, Ill. He was formerly general manager of the Lehigh Lime Co.

W. G. Moncrieff has been elected chairman of the board of the Swan & Finch Co., New York, manufacturer of refined oils, succeeding Henry Fletcher, resigned.

Frank Nickerson, for 9 years connected with the San Francisco office of the Midvale-Cambria Steel Co., has severed his connection with that company to accept the position as southern California manager for the Bethlehem Steel Corporation. About the first of January he will open an office in the Washington Building, Third and Spring Sts., Los Angeles, Calif., for the Bethlehem Steel Corporation, covering all of southern California and Arizona.

Prof. Frederick Soddy, of Oxford, England, and Dr. F. W. Aston, research fellow of Trinity College, Cambridge, England, have each been awarded a Nobel prize, for 1921 and 1922, respectively.

The board of governors of the Synthetic Organic Chemical Manufacturers' Association of the United States has elected H. F. Wilmot technical adviser to the association in matters involving administration of customs duties under the present tariff act. Mr. Wilmot was president and a director of the Tinc Tura Laboratories, Brooklyn, N. Y., and has severed his connection with that organization in order to devote his entire time to his new duties with the association. His office will be Room 1648, Equitable Building, 120 Broadway, New York City.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

In the Upward Swing of the Business Cycle

Basic Industries Continue to Gain as Commodity Prices Rise and the Volume of Manufacture Shows Substantial Increase

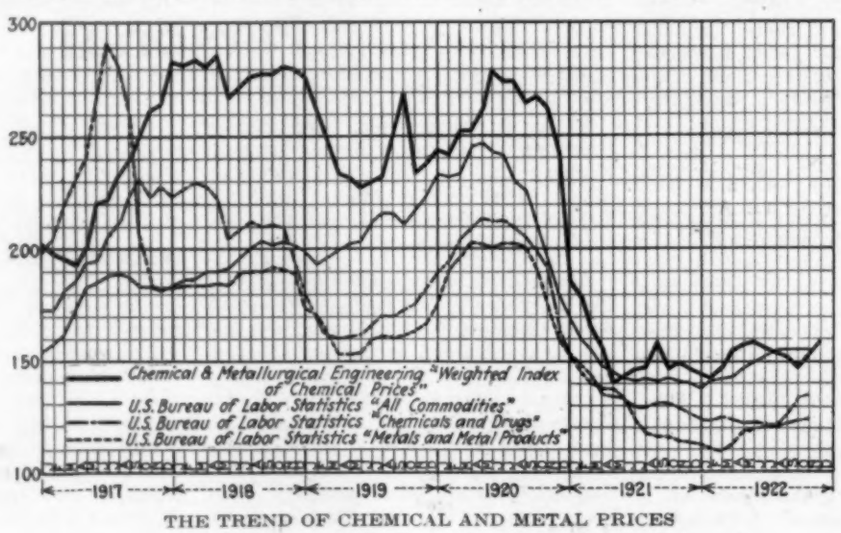
Forecast: *The outlook for the remainder of 1922 and the first half of 1923 is for rising wholesale prices and an expansion of business activity, with the strong probability of a continuation of the upward swing during the second half of next year. The recovery of business has been very substantial, as shown by the marked rise of the business curve of our index chart since January.*—Harvard Economic Service.

A BROAD SURVEY of present industrial conditions reveals abundant evidence that we are in the upward swing of the business cycle. Ever since the beginning of the year there has been an advancing level of prices together with a substantial increase in productive activity. Starting at first with the basic industries of iron and steel, fuel, building materials and agricultural products, this movement has broadened until at the present time practically every line of business activity has been favorably affected by it. October and November marked almost complete recovery from the labor troubles that had threatened to tie up the transportation and coal supply of the country. Production in the bituminous mines has so far exceeded current consumptive requirements that now we are practically on an even footing with 1921. Car loadings during October were at a maximum and by Nov. 1 the shortage of railroad cars was the largest on record. An expected seasonal decline in revenue freight loadings, however, during the week ended Nov. 8 reduced this shortage to 174,498 cars, a decrease of 4,000 cars. Additional relief during the week ended Nov. 15 reduced the shortage to 153,291 cars, but the transportation situation is still a serious obstacle in the path of further business expansion.

Rising Prices

Following the decline in September there has been a sharp rise in wholesale prices that has affected practically all commodities. The Bureau of Labor Statistics' general index had increased from 138 to 155 during the period January to August. In September lower prices for coal caused the index to drop to 153, but October marked a recovery to 154. Especial strength was shown in the textile, hide and leather, chemical and metal groups. From Oct. 1 to Nov. 1 Bradstreet's index rose from $12.5039 to $13.3482, a gain for the month of 6.7 per cent. This marks the highest level since December, 1920, and is the fourteenth month in the past seventeen that this index has advanced.

During the early months of 1922 the commodities on which *Chemical & Metallurgical Engineering's* weighted index of chemical prices is based showed a more striking increase than was evident for most commodities. The result was that some readjustment took place during the summer months and from its high level of June this index fell steadily during July, August and September. In October it stood at 153.10 and the effects of the tariff had just begun to be felt. During November there was substantial increase and the average for the month was 159.77, the highest point reached since early in 1921.



THE TREND OF CHEMICAL AND METAL PRICES

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

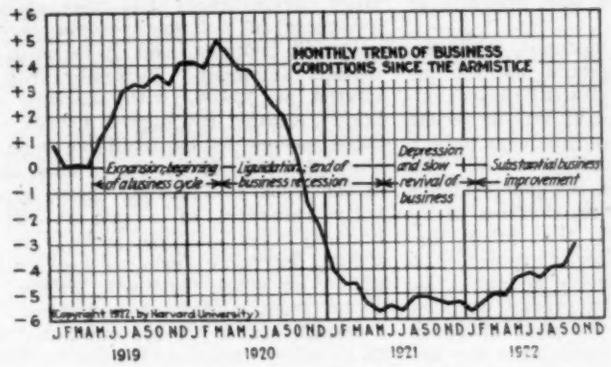
This week	160.60
Last week	162.45
December, 1921	145
December, 1920	245
April, 1918 (high)	286
April, 1921 (low)	140

Included in this index are acetic, citric, hydrochloric, nitric, and sulphuric acids, ethyl and methyl alcohols, anhydrous ammonia, ammonium sulphate, barium chloride, bleaching powder, borax, caustic potash, caustic soda, copper sulphate, formaldehyde, glycerine, potassium carbonate, salt cake, soda ash, sulphur, benzene, aniline, and cottonseed and linseed oils.

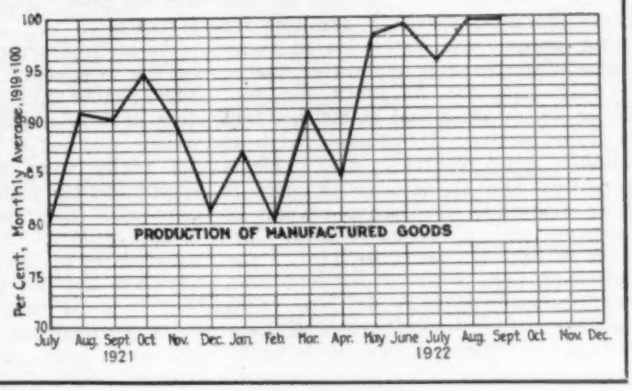
The expanding volume of manufacture has been accompanied by increased employment in industrial establishments. Gains in the total amount of the payrolls in October as compared with September indicated larger earnings for the individual workers. The Department of Labor reports are based on 3,064 establishments in 43 different manufacturing industries employing 1,525,785 workers and paying out $47,051,229 per week in wages. Comparing the figures for October, 1922, with those for identical establishments for September, 1922, there were increases in the number of employees in 29 of the 43 industries. Glass, foundry and machine shops, textiles, iron and steel and chemicals show increases ranging from 5.9 to 4.6 per cent. Strikes in the pottery industry caused a decrease in employment in that industry of 30.9 per cent. Fertilizers, largely because of seasonal character, showed a decrease of 6.8 per cent. Thirty-four of the 43 industries reported increases in their payrolls for October as compared with September. Since the increase in payroll accounts are greater than the increase in numbers employed, it is evident that wages have been advanced or that hours of work have been extended.

The output of pig iron and steel

Trend of business conditions in the United States based on Bradstreet's price index and bank clearings outside of New York as computed by Harvard Economic Service.



Index of the volume of manufacture of steel, lumber, paper, petroleum, textiles, leather, food and tobacco compiled by Federal Reserve Board.



ingots, the consumption of cotton and silk and the output of portland cement all exceeded in October any previous month since 1920. The production of pig iron for October was the largest for any month since December, 1920, and exceeded by more than 200,000 tons the production for July, which was the record month for 1922.

The total production of newsprint in October was 130,682 net tons, as compared with 101,884 tons in October, 1921. This brings the total for 10 months of 1922 up to 1,200,301 tons, or about 188,000 tons more than for the same period of the preceding year.

Stocks of hides and skins at the end of September, the last month for which statistics are available, showed another increase and were the largest since last March. The production of sole and belting leather increased, although less upper leather was made than in August.

Cement production during October was 12,287,000 bbl., a new high record. This compares with 10,506,000 bbl. in October, 1921.

Meltings of raw sugar were somewhat less than in September (280,003 long tons, as compared with 321,909 tons), but nevertheless exceeded those for October, 1921.

The Stock Market Reaction

After security values had a phenomenal rise and the *Wall Street Journal* average for twenty industrials had reached a new high value for the year of $103.43, a sharp decline set in, affecting the common stock of a wide range of companies. Various reasons have been assigned for this reaction, but the one most generally held is that it represents the accumulation of a number of disquieting economic developments. Prominent among these is the situation in Congress and the threatening passage of class legislation such as the ship subsidy, farmers' loans, governmental financing of plans for the distribution of farm products, proposed re-enactment of the excess profits tax, reduction of freight rates and amendments to the Federal Reserve act. Should such radical measures be enacted into law at this time it is evident that a fatal blow would be dealt to the future improvement of business.

The St. Louis Market

ST. LOUIS, Mo., Nov. 29, 1922.

The firmness of the heavy chemical market during the past few weeks has been further exemplified by several important advances. These have tended toward inducing large buyers to anticipate their future requirements, resulting indirectly in a very active market. Stocks of most important items are very limited and on some items spot stocks are not to be located, while producers report having sold up their production for several months ahead. An easier feeling is observed for imported material, prices having fallen appreciably in some cases. Transportation facilities are somewhat better but are still below normal. It is evident that buyers should give this condition their serious consideration when placing orders.

Alkalis

Only routine business is being transacted in *caustic soda* and prices remain the same. The same may be said about *soda ash*, though more small purchases of ash are being made. Prices on ash are generally steady, though in a few instances they have been slightly shaded. *Bicarbonate of soda* has shown more life recently and prices are firmer than when we last reported. *Sal soda* has been fairly active recently and a number of good-sized less than carload lots orders have been placed. Quotations are as follows: Barrels, $1.65 per 100 lb.; kegs, $1.85; packages, $2 per case.

General and Special Chemicals

The heavy *mineral acids* have not been displaying unusual activity since our last report; however, the demand has been very good for this time of the year. No change in prices has been reported for some time, but the market is firming up quite a bit. Producers of *acetate of lime* have made a further advance in price which has also made a corresponding increase in *acetic acid* and *formaldehyde*, with quite a heavy demand for the latter, particularly in small lots. Supplies of *citric acid* are apparently adequate to meet the present demand, which is only moderate. Large quantities of imported material can be had, but domestic goods are not so free. *Oxalic acid* is reported very active, and the competition from imported goods has been keenly felt by the domestic manufacturers. *Aqua ammonia*, 26 deg., is very quiet, which is not unusual for this time of the year. *White arsenic, powdered*, is quoted at 14c. f.o.b. New York, with no spot goods available, and a further advance in price would not prove surprising. There is no relief looked for for some time, as the domestic production is very limited due to many of the American smelters having curtailed their operations. There has been very little change in the *copperas* situation, the demand still far exceeding the production. Prices have been very firm and no change is looked for in the immediate future.

Sales of moderate quantities are being made on *cream of tartar*, and while *tartaric acid* is generally active, the average sale involved is comparatively small. *Glycerine* has not changed; for some time the price has been firm at 18½c. in drums with a large volume of business being transacted. The market for *yellow prussiate of potash* is apparently devoid of any spot stocks, and for future shipment from abroad prices are being quoted at around 38@38½c. f.o.b. New York. The demand for *sodium benzoate* has kept up unusually well considering the fact that the preserving and canning season has come to a close. *Zinc sulphate* remains very strong, with an extremely large demand. Prices are reported at 3½c. per lb. in carlots f.o.b. St. Louis, and at 3½ @4c. per lb. in less than carload lots f.o.b. St. Louis. The *zinc dust* market is very much improved, the product being quoted at 10c. per lb. in carloads, f.o.b. New York.

Vegetable Oils and Naval Stores

Castor oil, after declining to 13½c. in drums, has steadily held its own, and a present active demand would indicate no further decline for some time. Today's quotations for *linseed oil* do not differ greatly from recent reports. Single-barrel lots are being quoted at $1 basis raw oil; 5-bbl. lots at 92c., with the usual differential of 2c. for boiled over raw. *Turpentine* is slightly weaker than previously reported, the market today being $1.52 in 5-bbl. lots; $1.58 in single barrels, a decline of 10c.

On Nov. 20 a general advance in prices on *barytes, blanc fixe* and *whiting* became effective in this market. The largest producer here quotes as follows: *Barytes*, $26@$28 per ton for water ground and water floated material. Water ground and water floated *whiting* sells for $17@$19 per ton. *Blanc fixe* is being sold at $90 per ton. A good volume of business in these items is being reported. *Zinc oxide* is very firm and an advance in price is daily expected. An active market is reported, with prices as follows: Carloads in barrels, lead free, 7½c.; 5 per cent lead, 6½c.; 8 to 10 per cent lead, 6¼c. Carloads in bags, ½c. less. Less than carload lot prices, barrels, ½c. over carload lots. These prices are ex-warehouse St. Louis.

The Iron and Steel Market

PITTSBURGH, Dec. 1, 1922.

There is no evidence of any decrease in the rate of steel production, which was, in ingots, at the rate of 40,000,000 tons a year in October and probably ran a trifle above that in November. There is an increase of fully 15 per cent over the average rate April to September inclusive, when production was less than the demands of buyers, although it is not certain that buyers would have been as anxious to obtain heavy deliveries if the coal strike had not occurred.

Shipping conditions are far from good, but they permit of shipments fully equal to current production, while only a few producers desire greater facilities for moving coal and coke than have been at their command in the past few weeks. Some consignees are affected by the many embargoes.

The finished steel market as a whole is very quiet in point of tonnage turnover, and indeed has been very quiet for more than a month. Mill operations are based very largely on old orders and interest centers mostly on the question of how long old orders will carry the mills. The Steel Corporation is booked many months ahead in most of its lines. Among the independents, there are heavy order books in tubular goods and a fairly large tonnage in wire products, with a moderate tonnage in merchant bars. In plates, shapes, tin plate and sheets there is not so much business, and in the case of some mills not enough to support the present operating rate fully through December.

STEEL PRICES

A motion is prevalent that finished steel prices are destined for declines in the not distant future. The distinction is not made as clearly as it should be between bars, shapes and plates, in normal times the market leaders, and pipe, wire, sheets and tin plate. The former group, if the market be taken as really established at 2c., are distinctly high, their low point having been 1.35c., early in March. The other products have advanced less in dollars per ton and much less in percentage. The effect of wage advances since March, counteracted in part by reductions in freight rates, represent a net increase in cost of something like $5 a net ton upon finished steel products as a whole.

As to prospective declines, while 2c. is the commonly quoted market on bars, shapes and plates, attractive orders have been going at less in recent weeks, so that a readjustment might not really mean much after all. In sheets and tin plates, the independents have not fully recovered from their disappointment that the price announcement of the Steel Corporation 8 days ago did not involve advances, so that it is no time to predict declines in those quarters. In pipe, there is still great pressure upon mills for deliveries, particularly in the smaller sizes, and the same is true to an extent of nails. Tubular goods may be considered very strong marketwise and wire products moderately strong. Markets are: Wire, 2.45c.; nails, $2.70; blue annealed sheets, 2.50c.; black sheets, 3.35c.; galvanized sheets, 4.35c.; automobile sheets, 4.70@5c.; merchant pipe, 66 per cent basing discount.

The sheet bar market is poorly defined and will not be well established until business comes to be done on a large scale for the first quarter of next year. The usual contract price for the current quarter was $38 Pittsburgh or Youngstown. For a time prompt lots brought $40 readily. Recently there have been sales at various prices, particularly sales by Cleveland producers to Cleveland consumers, at less than $38, but from such sales one cannot compute a market price at the usual basing points Pittsburgh and Youngstown from the awkward circumstance that one does not know whether adding or deducting the freight would be the proper thing. Probably some tonnage of fourth quarter business will have to be carried over on account of buyers not being able to specify in full. A fair guess seems to be that the first quarter market will not be under $33 nor over $35. Billets, which are but lightly traded in, are commonly quotable at the same price as sheet bars.

COKE AND PIG IRON

A week ago it was noted that coke was not running with coal, coke having advanced, while coal had declined. This week coal is at variance with itself. Pittsburgh steam coal is quotable at $2.75 and Connellsville steam coal, probably chiefly Sewickley vein, at $2.25@$2.50, whereas reasonably good byproduct coal is all of $3 and good grades run up to $3.50 at least, Youghiogheny gas coal is at approximately the same range. In normal times the differences between grades are relatively very slight. Connellsville furnace coke for spot or prompt shipments is $7.25@$7.50, but with $8 or more quoted for regular shipment over December, and $8 quoted for first quarter, prices which do not interest furnacemen.

Valley pig iron has continued to decline. Transactions do not run into tonnage, and there are variations between prices in actual sales, suggesting either that buyers do not cover the market ground carefully or consider other circumstances than price, such as quickness of delivery. Some carload sales of foundry iron have required instant shipment. Bessemer iron is offered at $28.50, with scarcely any takers, against $30 quoted a week ago. Basic seems to be available now at about $25.50. There was a sale early in the week at $26 and report, apparently authentic, of a sale at $27.50. Foundry iron can be picked up at $26.50, but some furnaces are getting $27.50 on single carloads, chiefly, no doubt, from consumers accustomed to a certain brand. Prices mentioned are f.o.b. valley furnaces, freight to Pittsburgh being $1.77.

The New York Market

NEW YORK, Dec. 4, 1922.

The chemical and allied markets showed only moderate activity during the past week, due probably to the intervening holiday. The outstanding interest of the week was again centered around the arsenic market and new high levels for the year were recorded. Producers of acetic acid advanced all grades, because of the recent rise in the price of acetate of lime and they report a steady demand from consumers for fair-sized packages. American refiners announced a second advance of 3c. per lb. in camphor, bringing present figures around 96c. per lb. Manufacturers of bleaching powder report a heavily sold up condition at the works and are quoting high prices for early shipments. Prussiate of soda has shown some tendency to ease and prices were somewhat lower during the late trading. Prussiate of potash, on the other hand, was scarce, with the demand very strong for the yellow and red varieties. The alkali market continued along steady lines at the same levels as previously recorded. Export demand was for moderate quantities and came chiefly from Italy and Japan. The domestic demand continued exceptionally active and contracts over 1923 were recorded among leading producers. Barium chloride, formaldehyde, permanganate of potash, bichromate of potash and soda, sodium acetate and cyanide continued along steady lines, with very little selling pressure in any direction.

GENERAL AND SPECIAL CHEMICALS

Alcohol—Leading producers report a fairly active demand from consumers and state that supplies are sold ahead for the remainder of the year. Secondhand stocks have been greatly diminished and competition was less noticeable. Producers quote denatured 188 proof No. 1 formula at 37@39c. per gal. Methanol continued at $1 per gal. in drums for the 95 per cent and $1.03 per gal. for the 97 per cent.

Arsenic—Commercial material recorded a new high record for the year when spot material sold at 15c. per lb. Domestic producers are heavily sold

ahead and importers are experiencing some difficulty in obtaining any appreciable tonnages from Japan or Germany. Shipments have sold up to 14c. per pound.

Bleaching Powder—Producers have been unable to offer any prompt shipments and prices have advanced to $2.25 per 100 lb. f.o.b. works. Consuming demand is quite satisfactory and several contracts over 1923 were reported around $1.90@$2 per 100 lb. in large drums, f.o.b. works.

Carbonate of Potash—Calcined 80-85 per cent was quoted around 6c. per lb. Shipments were held at 5½c. per lb., duty paid. Hydrated 80-85 per cent was very scarce at 8c. per pound.

Caustic Potash—Imported 88-92 per cent material was steady at $6.50 per 100 lb. on spot. Shipment prices were at the same levels as spot goods.

Caustic Soda—Export demand has not shown any noticeable change and leading sellers quoted the market around $3.50@$3.60 per 100 lb., f.a.s. N. Y. The domestic inquiry continued exceedingly strong at $3.75@$4 per 100 lb., ex-store. Contracts over 1923 were recorded at $2.50 per 100 lb., basis 60 per cent, carload lots, f.o.b. works.

Copper Sulphate—Producers reported a very good demand and stated that November, 1922, business was more than double that of November, 1921. The insecticide and agricultural industries are showing inclinations for future requirements. Standard 99 per cent large crystals were quoted at $5.75 per 100 lb., in carload quantities.

Prussiate of Potash—Yellow material was very strong during the early part of the week, but later reacted somewhat. Prices opened around 40c. per lb. and declined to 39½c. Red material was scarce at 95c. per pound.

Prussiate of Soda—The general tone of the market was barely steady and prices recorded a fractional decline. Consumers showed very little desire to purchase any round quantities and resale merchants quoted down to 21c. per lb. for spot goods.

Coal-Tar Products

Dealers in crudes and intermediates reported a steady tone to the market, with supplies in several items heavily sold ahead for the remainder of the year and well into 1923. Among the most important were benzol, cresylic acid, solvent naphtha, salicylic acid and phenol. Producers of salicylic acid announced another increase of 5c. per lb. on the U.S.P. and technical grade.

Benzol—There has been no material relief in this market, even though producers announced increased production. Spot goods remain in very limited supply at 38@40c. per gal. for 90 per cent.

Cresylic Acid—Spot goods are in limited supply and prices are quite firm. Sales of 97-99 per cent material were recorded around 85c. per gal., with 95 per cent goods at 80c. Producers quote unchanged prices for contracts, but report a heavily sold up condition.

Phenol—The market exhibited signs of weakness, due to the sudden advance in quotations. Consumers showed little inclination to purchase at the present high levels and second-hand dealers were eager to book business as low as 32c. per pound.

Aniline Oil—The demand continued along steady lines and sellers' quotations were firm around 16@17c. per lb. Aniline salts also showed a tendency to maintain current figures and were held at 24@26c. per pound.

Beta Naphthol—The technical material is held firm among leading factors at 25@26c. per lb. Consumers have shown greater interest and purchases were for larger packages. The general range is around 24@26c. per pound.

Salicylic Acid—Producers announced an advance of 5c. per lb., bringing present levels for U.S.P. to 40c. per lb. Demand is fairly active and producers report a satisfactory volume of business at the works. Higher costs of raw material were responsible for the late advances.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.	.....	$0.39 – $0.45
Acetone	lb.	$0.21 – $0.21½	.21½ – .22
Acid, acetic, 28 per cent	100 lb.	3.50 – 3.60	3.65 – 4.00
Acetic, 56 per cent	100 lb.	7.00 – 7.15	7.20 – 7.50
Acetic, glacial, 99½ per cent, carboys,	100 lb.	14.00 – 14.25	14.30 – 14.50
Boric, crystals	lb.	.11 – .11½	.11½ – .12
Boric, powder	lb.	.11 – .11½	.11½ – .12½
Citric	lb.	.....	.51 – .52
Hydrochloric, 18 deg.	100 lb.	.90 – 1.00	1.05 – 1.20
Hydrochloric, 20 deg.	100 lb.	1.00 – 1.10	1.20 – 1.40
Hydrofluoric, 52 per cent	lb.	.11 – .11½	.11½ – .12
Lactic, 44 per cent tech.	lb.	.11 – .11½	.11½ – .12
Lactic, 22 per cent tech.	lb.	.05 – .05½	.05½ – .06
Muriatic, 20 deg. (see hydrochloric)		.....	.....
Nitric, 40 deg.	lb.	.05½ – .05½	.06 – .06½
Nitric, 42 deg.	lb.	.06 – .06½	.06½ – .07
Oxalic, crystals	lb.	.15 – .15½	.15½ – .16
Phosphoric, 50 per cent solution	lb.	.07½ – .08	.08½ – .09
Picric	lb.	.20 – .22	.23 – .27
Pyrogallic, resublimed	lb.	.....	1.65 – 1.75
Sulphuric, 60 deg., tank cars	ton	9.00 – 10.00	.....
Sulphuric, 60 deg., drums	ton	12.00 – 14.00	.....
Sulphuric, 66 deg., tank cars	ton	14.50 – 15.00	.....
Sulphuric, 66 deg., drums	ton	19.00 – 20.00	20.50 – 21.00
Sulphuric, 66 deg., carboys	ton	.....	.....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 – 20.00	.....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 – 22.50	23.00 – 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	.....	.60 – .75
Tannic (tech.)	lb.	.40 – .45	.46 – .50
Tartaric, imported crystals	lb.	.....	.30½ – .31
Tartaric acid, imported, powdered	lb.	.....	.31 – .32
Tartaric acid, domestic	lb.	.....	..... .32
Tungstic, per lb. of WO	lb.	.....	1.00 – 1.20
Alcohol, ethyl (Cologne spirit)	gal.	.....	4.75 – 4.95
Alcohol, methyl (see methanol)		.....	.....
Alcohol, denatured, 188 proof No. 1	gal.	.....	.37 – .39
Alcohol, denatured, 188 proof No. 5	gal.	.....	.36 – .38
Alum, ammonia, lump	lb.	.03½ – .03½	.04 – .04½
Alum, potash, lump	lb.	.03½ – .03½	.03½ – .04
Alum, chrome lump	lb.	.05 – .05½	.05½ – .06
Aluminum sulphate, commercial	100 lb.	1.50 – 1.65	1.70 – 2.25
Aluminum sulphate, iron free	lb.	.02½ – .02½	.03 – .03½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.06½ – .07½	.07½ – .08
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .30½	.30½ – .31
Ammonium carbonate, powder	lb.	.09 – .09½	.09½ – .10
Ammonium nitrate	lb.	.06 – .06½	.06½ – .07½
Amylacetate tech.	gal.	.....	2.35 – 2.60
Arsenic, white, powdered	lb.	.15 – .15½	.15½ – .15½
Arsenic, red, powdered	lb.	.13½ – .14	.14½ – .15
Barium carbonate	ton	75.00 – 77.00	78.00 – 80.00
Barium chloride	ton	95.00 –100.00	102.00 –105.00

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Barium dioxide (peroxide)	lb.	.20 – .21	.21½ – .22
Barium nitrate	lb.	.08½ – .08½	.09 – .09½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 – .04½	.04½ – .04½
Blanc fixe, dry	lb.	.04 – .04½	.....
Blanc fixe, pulp	ton	45.00 – 55.00	.....
Bleaching powder	100 lb.	2.25 – 2.35	2.40 – 3.50
Blue vitriol (see copper sulphate)		.....	.....
Borax	lb.	.05½ – .05½	.06 – .06½
Brimstone (see sulphur, roll)		.....	.....
Bromine	lb.	.27 – .28	.28½ – .35
Calcium acetate	100 lb.	3.50 – 3.60	3.65 – 3.75
Calcium carbide	lb.	.04½ – .04½	.05 – .05½
Calcium chloride, fused, lump	ton	22.00 – 23.00	23.50 – 27.00
Calcium chloride, granulated	lb.	.01½ – .01½	.02 – .02½
Calcium peroxide	lb.	.....	1.40 – 1.50
Calcium phosphate, tribasic	lb.	.....	.15 – .16
Camphor	lb.	.....	.93 – .95
Carbon bisulphide	lb.	.07 – .07½	.07½ – .07½
Carbon tetrachloride, drums	lb.	.10 – .10½	.10½ – .12
Carbonyl chloride, (phosgene)	lb.	.....	.60 – .75
Caustic potash (see potassium hydroxide)		.....	.....
Caustic soda (see sodium hydroxide)		.....	.....
Chalk, precip.—domestic, light	lb.	.04½ – .04½	.....
Chalk, precip.—domestic, heavy	lb.	.03½ – .03½	.....
Chalk, precip.—imported, light	lb.	.04½ – .05	.....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05½ – .06	.06½ – .06½
Chloroform	lb.	.....	.35 – .38
Cobalt oxide	lb.	.....	2.10 – 2.40
Copperas	ton	27.00 – 28.00	29.00 – 30.00
Copper carbonate, green precipitate	lb.	.21 – .21½	.22 – .22½
Copper cyanide	lb.	.....	.50 – .55
Copper sulphate, crystals	100 lb.	5.75 – 6.00	6.10 – 6.50
Cream of tartar	lb.	.....	.25½ – .26
Epsom salt (see magnesium sulphate)		.....	.....
Ether, U.S.P. 100 drums	lb.	.....	.14 – .15
Ethyl acetate com. 85%	gal.	.....	.72 – .75
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.....	.90 – .95
Formaldehyde, 40 per cent	lb.	.14 – .14½	.14½ – .15
Fullers earth, f.o.b. mines	net ton	16.00 – 17.00	.....
Fullers earth—imported powdered	net ton	30.00 – 32.00	.....
Fuse oil, ref.	gal.	.....	3.00 – 3.50
Fusel oil, crude	gal.	.....	2.00 – 2.25
Glauber's salt (see sodium sulphate)		.....	.....
Glycerine, c.p. drums extra	lb.	.....	.18½ – .18½
Iodine, resublimed	lb.	.....	4.40 – 4.50
Iron oxide, red	lb.	.....	.12 – .18
Lead acetate, white crystals	lb.	.....	.12 – .12½
Lead arsenate, powd.	lb.	.14 – .14½	.14½ – .15
Lead nitrate	lb.	.....	.15 – .20
Litharge	lb.	.07½ – .08	.08½ – .09
Magnesium carbonate, technical	lb.	.06 – .06½	.06½ – .07½
Magnesium sulphate, U.S.P.	100 lb.	2.50 – 2.65	2.70 – 3.50
Magnesium sulphate, technical	100 lb.	.....	1.00 – 1.80
Methanol, 95%	gal.	.....	1.00 – 1.07
Methanol, 97%	gal.	.....	1.03 – 1.10

		Carlots F.o.b. N.Y.	Less Carlots F.o.b. N.Y.
Nickel salt, double	lb.	..... –	$0.11 –$0.11½
Nickel salt, single	lb.	..... –	.12 – .12½
Phogene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	..... –	.40 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35½
Potassium bichromate	lb.	$0.09½ – .10	.10½ – .10½
Potassium bromide, granular	lb.	..... –	.17 – .23
Potassium carbonate, U. S. P.	lb.	.12 – .12½	.13 – .16
Potassium carbonate, 80-85%	lb.	.06 – .06½	.06½ – .06½
Potassium chlorate, powdered and crystals	lb.	.07½ – .08	.08½ – .09
Potassium cyanide	lb.	..... –	.55 – .57
Potassium hydroxide (caustic potash)	100 lb.	6.50 – 6.60	6.65 – 7.00
Potassium iodide	lb.	..... –	3.45 – 3.55
Potassium nitrate	lb.	.06½ – .06½	.07 – .08
Potassium permanganate	lb.	.16 – .16½	.16½ – .17
Potassium prussiate, red	lb.	..... –	.93 – .95
Potassium prussiate, yellow	lb.	.39½ – .39½	.40 – .41
Rochelle salts (see sodium potas. tartrate)		..... –	..... – .....
Salammoniac, white, granular	lb.	.06½ – .06½	.07 – .07½
Salammoniac, gray, granular	lb.	.08 – .08½	.08½ – .08½
Salsoda	100 lb.	1.20 – 1.40	1.45 – 1.60
Salt cake (bulk)	ton	25.00 –27.00	..... – .....
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 – 1.67	2.00 – 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 – 1.80	1.85 – 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 – 1.90	1.95 – 2.40
Sodium acetate	lb.	.07½ – .07½	.08 – .08½
Sodium bicarbonate	100 lb.	1.75 – 1.85	1.90 – 2.30
Sodium bichromate	lb.	.07½ – .07½	.08 – .08½
Sodium bisulphate (nitre cake)	ton	4.50 – 4.60	4.65 – 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04½ – .04½	.04½ – .05½
Sodium chlorate	lb.	.06½ – .07	.07½ – .07½
Sodium chloride	long ton	12.00 –13.00	..... – .....
Sodium cyanide	lb.	.19½ – .21	.21½ – .25
Sodium fluoride	lb.	.09½ – .09½	.10 – .10½
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 – 3.40	3.75 – 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.50 – 3.60	3.65 – 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 – 3.90	4.25 – 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 – 4.15	4.40 – 4.60
Sodium hyposulphite	lb.	.02½ – .02½	.03 – .03½
Sodium nitrite	lb.	.08½ – .09	.09½ – .09½
Sodium peroxide, powdered	lb.	.28 – .30	.31 – .35
Sodium phosphate, dibasic	lb.	.03½ – .04	.04½ – .04½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.18 – .21
Sodium prussiate, yellow	lb.	.21 – .21½	.21½ – .22
Sodium silicate, (40 deg. in drums)	100 lb.	1.25 – 1.30	1.35 – 1.50
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 – 2.40	2.45 – 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 – .95	1.00 – 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04½ – .04½	.04½ – .05
Sodium sulphite, crystals	lb.	.03½ – .03½	.03½ – .04½
Strontium nitrate, powdered	lb.	.09 – .10	.10½ – .12
Sulphur chloride, yellow	lb.	.04½ – .05	.05½ – .06
Sulphur, crude	ton	18.00 –20.00	..... – .....
Sulphur dioxide, liquid, cylinders extra	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	2.00 – 2.15	2.20 – 2.70
Talc—imported	ton	30.00 –40.00	..... – .....
Talc—domestic powdered	ton	18.00 –25.00	..... – .....
Tin bichloride	lb.	.11 – .11½	.11½ – .11½
Tin oxide	lb.	..... –	.43 – .45
Zinc carbonate	lb.	.14 – .14½	.14½ – .15½
Zinc chloride, gran.	lb.	.07 – .07½	.07½ – .08
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc oxide, XX	lb.	.07½ – .08	.08½ – .08½
Zinc sulphate	100 lb.	2.75 – 3.00	3.95 – 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.90 —	$0.95
Alpha-naphthol, refined	lb.	1.05 —	1.10
Alpha-naphthylamine	lb.	.28 —	.30
Aniline oil, drums extra	lb.	.16 —	.17
Aniline salts	lb.	.22 —	.24
Anthracene, 80% in drums (100 lb.)	lb.	.75 —	1.00½
Anthracene, 80%, imported in drums, duty paid	lb.	.65 —	.70½
Benzaldehyde U.S.P.	lb.	1.25 —	1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 —	.35
Benzene, 90%, in drums (100 gal.)	gal.	.28 —	.32
Benzene, 90%, in drums, resale	gal.	.37 —	.40
Benzidine, base	lb.	.85 —	.90
Benzidine sulphate	lb	.75 —	.80
Benzoic acid, U.S.P.	lb.	.72 —	.75
Benzoate of soda, U.S.P.	lb.	.57 —	.65
Benzyl chloride, 95-97%, refined	lb.	.25 —	.27
Benzyl chloride, tech.	lb.	.20 —	.23
Beta-naphthol benzoate	lb.	3.75 —	4.00
Beta-naphthol, sublimed	lb.	.55 —	.60
Beta-naphthol, tech	lb.	.25 —	.26
Beta-naphthyla mine, technical	lb.	1.00 —	1.25
Carbasol	lb.	.75 —	.90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 —	.20
Ortho-cresol, in drums (100 lb.)	lb.	.18 —	.22
Cresylic acid, 97-99%, straw color, in drums	gal.	.60 —	.65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 —	.58
Cresylic acid, 97%, resale	gal.	.90 —	.95
Dichlorbenzene	lb.	.07 —	.09
Diethylaniline	lb.	.50 —	.60
Dimethylaniline	lb.	.39 —	.41
Dinitrobenzene	lb.	.20 —	.22
Dinitrocolorbenzene	lb.	.22 —	.23
Dinitronaphthalene	lb.	.30 —	.32
Dinitrophenol	lb.	.32 —	.34
Dinitrotoluene	lb.	.22 —	.24
Dip oil, 25%, car lots, in drums	gal.	.25 —	.30
Diphenylamine	lb.	.54 —	.56
H-acid	lb.	.75 —	.80
Meta-phenylenediamine	lb.	.90 —	1.00
Monochlorbenzene	lb.	.08 —	.10
Monoethylaniline	lb.	.95 —	1.10
Naphthalene crushed, in bbls.	lb.	.06 —	.06
Naphthalene, flake	lb.	.06 —	.06
Naphthalene, balls	lb.	$0.07 —	$0.07
Naphthionate of soda	lb.	58 —	.65
Naphthionic acid, crude	lb.	.65 —	.70
Nitrobenzene	lb.	.10 —	.12½
Nitro-naphthalene	lb.	.30 —	.35
Nitro-toluene	lb.	.15 —	.17
N-W acid	lb.	1.20 —	1.30
Ortho-amidophenol	lb.	2.25 —	2.30
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.85 —	.90
Ortho-nitro-toluene	lb.	.10 —	.12
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.20 —	1.25
Para-amidophenol, HCl	lb.	1.25 —	1.30
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.50 —	1.55
Para-toluidine	lb.	.85 —	.90
Phthalic anhydride	lb.	.37 —	.50
Phenol, U. S. P., drums	lb.	.34 —	.35
Pyridine, domestic	gal.	1.60 —	1.75
Pyridine, imported	gal.	1.40 —	1.60
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls.	lb.	.35 —	.37
Salicylic acid, U. S. P.	lb.	.40 —	.42
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.37 —	.40
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.20 —	.23
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.35 —	.37
Toluene, in drums	gal.	.40 —	.43
Xylidines, drums, 100 gal.	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.45 —	.50
Xylene, pure, in tank cars	gal.	.45 —	.....
Xylene, commercial, in drums, 100 gal.	gal.	.40 —	.42
Xylene, commercial, in tank cars	gal.	.30 —	.....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.28 —	$0.30
Beeswax, refined, dark	lb.	.30 —	.32
Beeswax, refined, light	lb.	.34 —	.35
Beeswax, pure white	lb.	.36 —	.40
Candellila, wax	lb.	.34 —	.35
Carnauba, No. 1	lb.	.39 —	.40
Carnauba No. 2, North Country	lb.	.23 —	.24
Carnauba, No. 3, North Country	lb.	.17 —	.18
Japan	lb.	.15 —	.15½
Montan, crude	lb.	.03½ —	.04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04 —	.04½
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½ —	.02½
Paraffine waxes, refined, 118-120 m.p.	lb.	.03½ —	.03½
Paraffine waxes, refined, 125 m.p.	lb.	.03½ —	.03½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 —	.04½
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½ —	.04½
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 —	.05½
Stearic acid, single pressed	lb	.09 —	.09½
Stearic acid, double pressed	lb.	.09½ —	.09½
Stearic acid, triple pressed	lb.	.10 —	.10½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$6.35 —	.....
Rosin E-I	280 lb.	6.45 —	.....
Rosin K-N	280 lb.	6.55 —	$7.00
Rosin W. G.-W. W	280 lb.	7.75 —	8.25
Wood rosin, bbl.	280 lb.	6.25 —	.....
Spirits of turpentine	gal.	1.52 —	1.53
Wood turpentine, steam dist.	gal.	1.35 —	.....
Wood turpentine, dest. dist.	gal.	1.25 —	.....
Pine tar pitch, bbl.	200 lb.	..... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	12.50
Retort tar, bbl.	500 lb.	..... —	11.00
Rosin oil, first run	gal.	.43 —	.....
Rosin oil, second run	gal.	.51 —	.....
Rosin oil, third run	gal.	.53 —	.....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		.90
Pine oil, pure, dest. dist.	gal.		.85
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pine wood creosote, ref.	gal.		.52

Fertilizers

Ammonium sulphate, f.a.s., N. Y., double bags	100 lb.	3.55 —	3.60
Blood, dried, f.o.b., N. Y.	unit	4.60 —	.....
Bone, 3 and 50, ground, raw	ton	42.00 —	44.00
Fish scrap, dom., dried, f.o.b. works	unit	3.10 —	3.20
Nitrate of soda	100 lb.	2.47½ —	2.50
Tankage, high grade, f.o.b. Chicago	unit	4.50 —	4.60
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	3.50 —	4.00
Tennessee, 78-80%	ton	7.00 —	8.00
Potassium muriate, 80%	ton	35.75 —	38.50
Potassium sulphate	unit	1.00 —	.....

Crude Rubber

Para—Upriver fine	lb.	$0.23½ —	.23½
Upriver coarse	lb.	.17½ —	.17½
Upriver caucho ball	lb.	.18 —	.18½
Plantation—First latex crepe	lb.	.25½ —	.26
Ribbed smoked sheets	lb.	.25½ —	.26
Brown crepe, thin, clean	lb.	.21 —	.22
Amber crepe No. 1	lb.	.21½ —	.22

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.12 —	$0.12½
Castor oil, AA, in bbls.	lb.	.12½ —	.13
China wood oil, in bbls.	lb.	.12½ —	.12¾
Coconut oil, Ceylon grade, in bbls.	lb.	.08¾ —	.08¾
Coconut oil, Cochin grade, in bbls.	lb.	.09 —	.09½
Corn oil, crude, in bbls.	lb.	.10½ —	.10½
Cottonseed oil, crude (f. o. b. mill)	lb.	.08½ —	....
Cottonseed oil, summer yellow	lb.	.10 —	.10½
Cottonseed oil, winter yellow	lb.	.11 —	.11½
Linseed oil, raw, car lots (domestic) bbls.	gal.	.85 —	.86
Linseed oil, raw, tank cars (domestic)	gal.	.81 —	.82
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.87 —	.89
Olive oil, denatured	gal.	1.12 —	1.15
Palm, Lagos	lb.	.07½ —	.07¾
Palm, Niger	lb.	.06¾ —	.07
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.10 —	.10½
Peanut oil, refined, in bbls.	lb.	.13½ —	.13¾
Rapeseed oil, refined in bbls.	gal.	.77 —	.78
Rapeseed oil, blown, in bbls.	gal.	.84 —	.85
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11 —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09 —	.09¼

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec, Canada	short ton	$650.00	$700.00
Asbestos, shingle stock, f.o.b., Quebec, Canada	short ton	60.00 —	80.00
Asbestos, cement stock, f.o.b., Quebec, Canada	short ton	15.00 —	17.00
Barytes, ground, white, f.o.b. mills	net ton	16.00 —	20.00
Barytes, ground, off color f.o.b. mills	net ton	13.00 —	21.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00 —	24.00
Barytes, crude f.o.b. mines	net ton	8.00 —	9.00
Casein	lb.	.10½ —	.13
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.00 —	8.00
China clay (kaolin) washed, f.o.b. Georgia	net ton	8.00 —	9.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	14.00 —	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaoli n)ground, f.o.b. Virginia points	net ton	13.00 —	20.00
China clay (kaolin), imported, lump	net ton	14.00 —	20.00
China clay (kaolin), imported, powdered	net ton	40.00 —	45.00
Feldspar, No. 1 pottery grade	long ton	5.50 —	7.00
Feldspar, No. 2 pottery grade	long ton	4.00 —	5.50
Feldspar, No. 1 soap grade	long ton	7.00 —	7.50
Feldspar, No. 1 Canadian, for mill	long ton	20.00 —	21.00
Graphite, Ceylon lump, first quality, f.o.b. N. Y	lb.	.05 —	.05½
Graphite, Ceylon chip	lb.	.04 —	.04½
Graphite, high grade amorphous crude	ton	35.00 —	50.00
Kieselguhr, f.o.b. mines, Cal.	per ton	40.00 —	....
Kieselguhr, f.o.b. N. Y.	per ton	50.00 —	55.00
Magnesite, crude, f.o.b. California mines	per ton	12.00 —	15.00
Pumice stone, imported	lb.	.03 —	.05½
Pumice stone, domestic, lump	lb.	.05 —	.05
Pumice stone, domestic, ground	lb.	.06 —	.07
Shellac, orange fine	lb.	.74 —	.75
Shellac, orange superfine	lb.	.76 —	.77
Shellac, A. C. garnet	lb.	.75 —	.77
Shellac, T. N.	lb.	.72 —	.73
Silica, glass sand, f.o.b. Indiana	per ton	1.75 —	2.50
Silica, sand blast material, f.o.b. Indiana	per ton	2.50 —	5.00
Silica, amorphous, 250 mesh, f.o.b. Illinois	per ton	17.00 —	17.50
Silica, building sand, f.o.b. Pa.	per ton	2.00 —	2.75
Soapstone, coarse, f.o.b. Vermont	ton	7.00 —	8.00
Talc, 200 mesh, f.o.b. Vermont	ton	7.00 —	12.00
Talc, 230 mesh, f.o.b. Georgia	ton	7.50 —	12.00
Talc, 200 mesh, f.o.b. Los Angeles	ton	15.00 —	17.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	per ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	net ton	50
Chrome cement, 40-50% Cr_2O_3	net ton	23–27
Chrome cement, 40-45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	23.00
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	43–46
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	39–41
Magnesite brick, 9-in. straight (f.o.b. works)	net ton	70–75
Magnesite brick, 9-in. arches, wedges and keys	net ton	85–90
Magnesite brick, soaps and splits	net ton	90
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	50–53
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.	1,000	45–47
Silicon carbide refractory brick, 9-in.	1,000	1100.00

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.11 —	.11½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.11½ —	.12
Ferromanganese, 78-82% Mn, Atlantic seaboard	gross ton	67.50 —	69.00
Spiegeleisen, 19-21% Mn	gross ton	36.00 —	37.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	70.00 —	72.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.90 —	.95
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	.....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, c.i.f. Atlantic seaboard	ton	18.50 —	19.00
Coke, foundry, f.o.b. ovens	net ton	7.50 —	8.00
Coke, furnace, f.o.b. ovens	net ton	7.25 —	7.50
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	15.00 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	17.50 —	19.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45 —	.....
Manganese ore, chemical (MnO_2)	net ton	75.00 —	80.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.80 —	.85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	lb.	.06 —	.08
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.11½ —	.12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.11½ —	.12
Pyrites, domestic, fines, f.o.b. mines, Ga.	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	.....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8.00 —	8.25
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	7.75 —	8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 —	3.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½ —	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic	13.875
Aluminum, 98 to 99 per cent.	22.00–23.00
Antimony, wholesale lots, Chinese and Japanese	6.50
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	36.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	36.00
Lead, New York, spot	7.10
Lead, E. St. Louis, spot	6.95
Zinc, spot, New York	7.30–7.35
Zinc, spot, E. St. Louis	6.95–7.05

OTHER METALS

Silver (commercial)	oz.	$0.64½
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent.	lb.	1.00@1.05
Platinum	oz.	$108.00
Iridium	oz.	240.00@275.00
Palladium	oz.	52.00@55.00
Mercury	75 lb.	71.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.00
Copper bottoms	30.00
Copper rods	19.75
High brass wire	18.75
High brass rods	16.75
Low brass wire	19.60
Low brass rods	20.25
Brazed brass tubing	23.00
Brazed bronze tubing	28.00
Seamless copper tubing	24.75
Seamless high brass tubing	22.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.00@11.25
Copper, heavy and wire	10.50@10.75
Copper, light and bottoms	8.50@ 8.75
Lead, heavy	4.50@ 4.75
Lead, tea	3.25@ 3.50
Brass, heavy	5.50@ 5.75
Brass, light	5.00@ 5.25
No. 1 yellow brass turnings	5.50@ 5.75
Zinc	2.25@ 2.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.90	$2.90
Soft steel bars	2.80	2.80
Soft steel bar shapes	2.80	2.80
Soft steel bands	3.40	3.40
Plates, ¼ to 1 in. thick	2.90	2.90

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

California

OAKLAND—The Rhodes-Jamieson Co. has commenced the operation of a new plant on the Oakland estuary, near High St., for the manufacture of composition tile products. It is proposed to develop an output of about 10,000 tiles per day. The company has a 5-acre tract to provide for future expansion.

SAN FRANCISCO—The San Francisco Sulphur Co., 624 California St., has filed plans and will commence the immediate erection of its proposed 1-story sulphur-refinery, 137x138 ft., on West Grant Ave., to cost about $35,000. The equipment installation will be arranged at an early date.

FRESNO—The Zellerbach Paper Co., Kern and H Sts., has awarded a contract to Minard & Casteel, 319 Abbey St., for extensions and improvements at its local works to cost about $12,000.

Connecticut

WATERBURY—The Gulf Refining Co., 364 Railroad Hill, will construct a new storage and distributing plant on South 5th St., with oil tanks, etc., to cost approximately $25,000.

Delaware

WILMINGTON—J. C. Rhoades & Sons, 11th St. and the Baltimore & Ohio R.R., manufacturers of leather products, are taking bids for the erection of a 1-story addition.

Florida

TAMPA—The Sulphur Springs Chemical Co. has preliminary plans in progress for the construction of a new plant in the Sulphur Springs section. James Langdon is president.

TAMPA — The Imperial Oil Co., 6006 Branch Ave., recently formed with a capital of $100,000, has plans under way for the construction of a new storage and distributing plant on local site, comprising a number of buildings, tanks, etc. A. M. Allen is general manager.

Iowa

WEST DAVENPORT—The Marquette Cement Mfg. Co., 140 South Dearborn St., Chicago, Ill., is taking bids for the erection of a new building at its local mill to cost about $100,000.

Louisiana

MONROE—The Keystone Carbon Co. has plans in progress for the erection of a new 2-unit carbon black plant on local site. The equipment installation will be arranged at an early date.

ELIZABETH—The Calcasieu Sulphur Co., recently organized under Delaware laws with a capital of $2,000,000, has plans in progress for the erection of a new local mill for the manufacture of kraft and other papers from pine and forest waste. A byproduct plant will be established for the production of turpentine, pine oil, rosin, etc. The initial unit will cost in excess of $150,000. J. F. Carter is general superintendent.

NEW ORLEANS — The Louisiana Celotex Co., manufacturer of fiber board products from sugar cane waste, has plans under way for the erection of two new plant units, to treble the capacity of the present mill. The work is estimated to cost about $1,000,000, including machinery. B. G. Dahlberg is president.

Maine

SABATTUS—The Pine Tree State Rubber Heel Co., recently organized with a capital of $200,000, has acquired a local brick mill, and will commence the immediate installation of machinery for a new plant. The initial equipment will provide for a working force of about 40 persons, and this will be increased at an early date to about 100 operatives. Frank W. Hodges and Theodore D. Cowen, both of Malden, Mass., formerly connected with the Converse Rubber Co., of this place, are president and treasurer of the new organization, respectively.

BATH—The Texas Co., 17 Battery Place, New York, N. Y., manufacturer of petroleum products, is reported to have acquired the local shipyard of the Emergency Fleet Corp., and will use the property for a new oil storage and distributing plant.

Maryland

BALTIMORE—The Crown Oil & Wax Co., Pratt and 8th Sts., has plans in preparation for the construction of two new 1-story additions to cost about $13,000. Work will be commenced at an early date. The structures will replace the portion of the plant recently damaged by fire.

BALTIMORE—The Air Reduction Co., 342 Madison Ave., manufacturer of industrial oxygen, acetylene, etc., has plans in progress for the erection of a new plant on East Fayette St., near 11th St.

BALTIMORE—The Colonial Concrete Products Co. has awarded a contract to the John Waters Building Co., 28 East Centre St., for the construction of a 2-story plant addition, 15x100 ft. Theodore W. Pietsch, American Bldg., is architect.

BALTIMORE — The Baltimore Brick Co., Maryland Trust Bldg., will construct five additional kilns at its plants, three to be located at Highland Ave. and Monument St., and two at Loney's Lane and Monument St., estimated to cost about $15,000.

Massachusetts

WATERTOWN — The Hood Rubber Co., Nichols Ave., manufacturer of automobile tires and other rubber products, will soon commence the erection of a 4-story plant addition, to be known as Factory No. 53, estimated to cost approximately $60,000. F. C. Hood is general manager.

NORTH BROOKFIELD—The Asbestos Textile Co. will commence the immediate construction of a new addition, 30x50 ft. J. J. Lang is superintendent.

ACTON — Fire, caused by an explosion, Nov. 18, destroyed two of the mills at the local plant of the American Powder Co. An official estimate of loss has not been announced.

ANDOVER—The Tyer Rubber Co., recently reorganized, is planning for enlargements in its local plant for the production of additional lines of rubber goods, continuing in the manufacture of automobile tires, druggists' goods, etc. Stock has been issued for $530,000. Myron H. Clark is president, and Walter E. Piper, treasurer.

Michigan

MUSKEGON—The Central Paper Co. has commenced excavations for a new mill addition to cost about $200,000, including equipment.

Minnesota

DULUTH—The Universal Portland Cement Co., 210 South La Salle St., Chicago, Ill., is planning for the construction of a new 1- and 2-story mill at its plant in the Morgan Park section, estimated to cost about $235,000, including equipment. R. S. Huey is local superintendent.

Missouri

KANSAS CITY—The Kansas City Oxygen Gas Co., 1805 Grand Ave., is taking bids for the erection of a new 2-story ammonia and nitrate plant, 20x48 ft., at Centropolis Station.

ST. LOUIS—The Brauer Mfg. Co., manufacturer of leather products, has acquired a building at 817-19 North 17th St., for a new local plant. The structure will be remodeled and improved, and equipment installed at an early date.

Nevada

FALLON—The Board of Education will install a chemical laboratory in the new Churchill County High School, for which plans have been completed. Erection will be commenced at an early date.

BELLEHELEN — The Bellehelen Merger Mines Co., operating on a tract of about 75 acres, is perfecting plans for the construction of a new mill, with capacity of 50 tons per day, estimated to cost approximately $125,000. A. E. Strong, Denver, Colo., is consulting engineer.

New Jersey

TRENTON—The Maddock Pottery Co., 3rd St., manufacturer of chinaware, will make extensions and improvements in its local plant. The contract has been awarded to the Karno-Smith Co., Broad St. Bank Bldg.

TRENTON—The Semple Mfg. Co., recently organized to take over the assets of the Semple Rubber Co., defunct, will operate at the former mill of the Sanhican Rubber Co., in the Brookville section. Equipment from the former Semple works will be installed, and production concentrated on rubber tubes and tubing. C. H. Semple is president, and W. B. John, treasurer.

TRENTON—The Empire Tire & Rubber Co., Clinton Ave., will build a 1-story addition 50x90 ft.

BOUND BROOK — The Fischer-Sweeny Bronze Co., 312 Adams St., Hoboken, N. J., manufacturer of bronze, aluminum and other metal castings, has acquired a 1-story building at Bound Brook, totaling about 16,000 sq.ft. of floor space, and will use for a new foundry. It is purposed to concentrate operations at this location, and the present plants at Hoboken and Newark will be removed here.

New York

DUNKIRK—The Atlas Steel Corp. is perfecting plans for extensions and improvements at its local plant, and at its branch works at Charlerol, Pa., to cost in excess of $250,000, including equipment. L. J. Campbell is chairman of the board.

Ohio

SANDUSKY—The Diamond Fertilizer Co., Market St., is planning for the erection of a new 1-story addition to its plant, 100x140 ft.

CLEVELAND — The Cleveland Waterproof Paper Co., 2033 West 106th St., has acquired property on the Berea Road, N.W., near the line of the New York Central R.R., as a site for a new plant for the manufacture of waterproof and mothproof papers. Plans have been prepared and work will proceed at once.

CINCINNATI—The Cincinnati Galvanizing Co., McMicken St., has authorized plans for the erection of a new 2-story plant at Chickering and Spring Grove Aves., estimated to cost about $150,000, including equipment. C. J. Hiefer, 810 Fourth National Bank Bldg., is engineer.

WARREN—The Alloy Electric Steel Casting Co. has work nearing completion on a new foundry for the production of alloy steel castings, and plans to have the structure ready for operation early in the coming year. The equipment installation will include a 15-ton furnace.

SPRINGFIELD—The Fairbanks Co., manufacturer of piano plates and other castings, plans for the rebuilding of the portion of its plant destroyed by fire, Nov. 13, including pattern shop, with loss approximating $50,000, with equipment.

RITTMAN—The Ohio Match Co., Wadsworth, O., has authorized the preparation of plans for the construction of a new plant on local site. Details and estimates of cost will be made at once. Christian, Schwartzenburg & Gaede, 1900 Euclid Ave., Cleveland, are engineers.

Oklahoma

OKLAHOMA CITY—The Kenyon Brick & Tile Co., 2700 West 10th St., has plans in progress for the erection of additional units at its plant to increase the output to about 40,000 bricks per day. At a later date, further extensions will be made to advance the capacity to close to 100,000 bricks daily, with departments for the manufacture of face brick and ceramic tile. Considerable new equipment will be installed. A. W. Kenyon is president.

PERRY—G. T. Braden, Tulsa, Okla., has acquired a local site for the construction of oil refinery, with department for gas production from residual oils. Plans will be prepared at an early date.

PICHER—The Buffalo Mining Co. has tentative plans under consideration for the rebuilding of its milling plant, recently destroyed by fire with loss of about $100,000, including equipment.

Oregon

SALEM—The Oregon Pulp & Paper Co. has awarded a contract to Van Patten & Son, Salem, for the erection of a 4-story.

reinforced-concrete plant addition, to cost about $50,000.

OREGON CITY—The Hawley Pulp & Paper Co. is completing plans for the erection of a complete new plant unit to practically double the capacity of the present mill. It is estimated to cost close to $1,500,000, including machinery. W. F. Hawley, Sr., is president.

GRESHAM — The Columbia Brick Works have plans nearing completion for the construction of a new addition, consisting of a number of buildings, designed to double the present plant capacity. New kilns will be built and new machinery installed.

Pennsylvania

YORK—The Gilbert Wall Paper Co., 728 Linden Ave., Paul C. Gilbert, president, has rejected bids recently received for its proposed new plant, and will have revised plans prepared at an early date. The plant will be 2-story and basement, 85x325 ft., located at State St. and the Pennsylvania Railroad. A power house will also be built. New bids will be called late in January. J. A. Dempwolf, Casset Bldg., is architect.

PHILADELPHIA—The Department of Water, City Hall, is arranging an appropriation of $90,000 for the purchase of chemicals for the waterworks during the coming year.

MARS—The Velte Foundry & Machine Co. has tentative plans under consideration for the rebuilding of the portion of its foundry and pattern shop, destroyed by fire, Nov. 23, with loss estimated at about $40,000, including equipment.

LEWISTOWN—The American Refractories Co., Union Arcade, Pittsburgh, has acquired a large tract of property near Lewistown Junction, and plans for the development of the site for refractory production at an early date.

PHILADELPHIA — The Keystone Chemical Co. has leased property at 24th South Front St. for a local works.

South Carolina

EASLEY—The Easley Oil Mill Co. is said to be planning for the rebuilding of the portion of its local plant, destroyed by fire, Nov. 16, with loss estimated at $30,000, including equipment.

Tennessee

CHATTANOOGA—The Odorless Refrigerator Co., West 1st St., near Pine St., has construction in progress on a 2-story and basement addition, 80x125 ft., to be equipped as an enameling plant. W. H. Sears, 905 James Bldg., is architect. Gaston G. Rauol is president.

Texas

PIONEER—The American Oil Co., Tulsa, Okla., has completed plans for the construction of a new local oil refinery. The first unit will have a capacity of about 2,500 bbl. per day, and will be supplemented with a second unit of like size at an early date. T. J. Ryan is president.

STAMFORD—The Rule-Jayton Cotton Oil Mill Co. has completed plans and will break ground at an early date for its proposed new oil mill, estimated to cost in excess of $80,000.

Virginia

CLIFTON FORGE—Eugene Mathews & Co. are planning to purchase machinery for local clay mining operations, including grinding equipment, driers, etc., for preparing the material for market. Inquiries are being made.

West Virginia

CHARLESTON—The St. Albans Glass Mfg. Co., Massillon, O., has acquired a local plant for a new works. Extensions and improvements will be made to cost close to $30,000. Operations will be inaugurated at an early date. Louis P. Mauger is president.

CHARLESTON—The Owen Bottle Co., 1401 Nicholas Bldg., Toledo, O., is completing plans for its proposed new 1-story plant on local site, 120x200 ft., estimated to cost about $150,000, and will commence work at an early date. It will be an addition to the present plant now operated in this section. The Devore Co., Nicholas Bldg., Toledo, is engineer. E. D. Libbey is president.

PARKERSBURG — The Blackwood Electric Steel Co., recently organized with a capital of $150,000, has plans practically completed for a new local foundry for the manufacture of alloy steel castings, and will break ground at an early date. The installation will include an electric melting furnace. F. S. Blackwood, head of the Farrell-Cheek Foundry Co., Sandusky, O., is president and general manager of the new company.

Industrial Developments

RUBBER—The Goodyear Tire & Rubber Co., Akron, O., has increased production from 20,600 to 21,000 automobile tires per day, and plans to advance this to 26,000 casings daily at an early date.

Stockholders of the Smith Tire & Rubber Co., Passaic, N. J., are perfecting plans to take over the plant from the receiver, William L. Brunyate, at an early date, and will place the works in immediate operation.

The B. F. Goodrich Co., Akron, O., has increased production 2,000 tires a day since the early part of November.

The Boston Woven Hose & Rubber Co., Boston, Mass., is maintaining active production at its plant, with regular working force.

The Carlisle Tire Corp., Stamford, Conn., has closed its local plant, throwing about 135 men out of employment. Lack of orders, owing to the winter season, is said to be the cause.

The Firestone Tire & Rubber Co., Akron, O., is arranging for increased production at its local mill. The Miller Rubber Co. and the General Tire & Rubber Co., in this same district, are also advancing their outputs and adding to the working forces.

The Lee Tire & Rubber Co., Conshohocken, Pa., is maintaining full production at its local mill, with regular working quota.

METALS—The United States Smelting, Refining & Mining Co., Salt Lake City, Utah, is increasing operations at its local properties and adding to the working force.

The Keystone Foundry Co., Lebanon, Pa., is placing a new plant addition in service, recently completed, and will develop maximum output in the line of machine molded soft gray iron castings.

The Miami Copper Co., Miami, Ariz., is operating five sections of its concentrating plant, only one section being idle. The plant is now running on about 5,000 tons of ore per day, the production of the local mines.

The American Smelting & Refining Co. has placed its four copper furnaces at Matehaula, San Luis Potosi, Mexico, in full operation, with a total daily capacity of 950 tons of ore.

The Success Mining Co., Wallace, Idaho, is operating with two shifts at its mill, and plans to advance to a full three-shift basis in the near future. Production at the mines is being increased.

The Anaconda Copper Mining Co., Great Falls, Mont., is operating its local electrolytic plant at maximum capacity. It is reported that extensions will be made in the plant for greater output.

The Callahan Zinc-Lead Co., Cœur d'Alene, Idaho, has placed its local mill on a full time, capacity basis.

The Calumet & Hecla Mining Co., Calumet, Mich., is increasing the working forces at its mines and mill. Increased capacity is being developed at the smelter. More than 3,600 men are now employed.

IRON AND STEEL—The Falcon Steel Co., Niles, O., has resumed production on a full time basis at its local bank of 8 mills.

The Replogle Steel Co. has placed the second furnace in blast at its Wharton, N. J., plant, and is operating at the mill at its Scrub Oak mines. Mining operations at the latter point will be commenced at an early date.

The Reading Iron Co., Reading, Pa., is arranging to resume operations at its puddle mill at Birdsboro, Pa., early in December. The plant has been idle for about 24 months past. It is also expected to resume at the Birdsboro sheet mill at an early date.

The A. M. Byers Co., Pittsburgh, Pa., is operating its blast furnace in the Youngstown, O., district, with 70 puddle furnaces, two turns at the bar mill, and one turn at the plate mill.

The Thomas Iron Co., Dover, N. J., has recently completed a new concentrating mill at its Richards Mine, electrically operated, and will have the unit in full service in the near future.

The Inland Steel Co., Chicago, Ill., is advancing production to better than 75 per cent of normal at its local mills, the highest since the coal and railroad strikes.

The United States Steel Corp. is holding at 100 per cent capacity production at its Youngstown, O., plants.

The Weirton Steel Co. has placed its Clarksburg, W. Va., plant on a full capacity basis, with full working force, following a two-thirds output schedule, as operative for some time past.

The National Tube Co., Pittsburgh, Pa., has resumed operations at its local Riverside plant on a full capacity basis, giving employment to approximately 3,000 men.

The Republic Iron & Steel Co., Youngstown, O., has increased operations at its mills to approximately 80 per cent of normal.

MISCELLANEOUS — The General Chemical Co. is operating at its sulphuric acid plant at Pulaski, Va., and plans for the establishment of a new plant unit at an early date.

The Snyder Brick Co., Ottawa, O., is arranging to continue operations throughout the entire winter, for the first time in the history of the plant. An order has been taken for 1,000,000 hollow tile blocks.

Practically every paper mill in the New England district is running on a full-time basis, with full working forces. Newsprint plants are particularly busy, and have adopted an overtime schedule.

The Pittsburgh Plate Glass Co., Pittsburgh, Pa., is operating its plants at maximum capacity with full working forces.

The Forest Paper Co., Yarmouth, Me., has reopened its soda fiber mill, following a resumption in other departments. The wages of employees have been advanced. It is expected to develop full capacity at an early date.

All cement mills in the Lehigh Valley section of Pennsylvania are continuing operations at maximum capacity. A number of plants are arranging to maintain this schedule throughout the winter.

The National Carbon Co. has resumed production at its Clarksburg, W. Va., plant, after a shut-down of more than 24 months. Employment will be given to about 100 men, and this force will be advanced to the maximum of 250 men in the near future.

England, Walton & Co., Philadelphia, Pa., operating leather tanneries, is maintaining full production at its Chilhowee extract plant at Newport, Tenn., under 24-hour service. The output is devoted to tanning extracts.

Three out of four oil refineries at Brownwood, Tex., are now in operation, these being the plants of the Blue Ribbon Refining Co., 2,000 bbl. capacity; and Brownwood Producing & Refining Co., 400 bbl. daily capacity. The refinery of the Baney Refining Co., now idle, has a rated production of 400 bbl. per day.

The Corn Products Refining Co., New York, N. Y., has adopted a production schedule of 85 per cent of maximum at its Argo, Ill., plant, on a six-day week basis.

The Texas Farm Bureau Ribbon Cane Growers' Association, Lufkin, Tex., has commenced operations at a new local sirup mill, to be run on a co-operative basis. Following the installation of additional copper coils and other equipment, the output will be advanced.

Capital Increases, etc.

THE GENERAL PAPER CO., 411 5th Ave., New York, N. Y., has filed notice of increase in capital from $100,000 to $500,000 for expansion.

LEAS & MCVITTY, INC., 303 Vine St., Philadelphia, Pa., manufacturer of leather, has filed notice of increase in capital from $3,400,000 to $5,400,000 for proposed expansion.

THE DYE PRODUCTS & CHEMICAL CO., 200 5th Ave., New York, N. Y., has filed notice of increase in capital from $75,000 to $200,000 for general expansion.

THE NATIONAL TILE CO., Anderson, Ind., has filed notice of increase in capital from $545,000 to $872,000 for expansion.

ENGLAND, WALTON & CO., INC., Third and Vine Sts., Philadelphia, Pa., manufacturer of leather, is disposing of a bond issue of $1,500,000, a portion of the proceeds to be used for financing, expansion, etc. Spencer K. Mulford is president.

THE JOVA BRICK WORKS, INC., Roseton, N. Y., has filed notice of increase in capital from $56,000 to $500,000 for proposed expansion.

Property of the THURLOW STEEL WORKS, INC., Chester, Pa., including machinery and equipment, will be sold by E. Wallace Chadwich and Howard M. Lutz, receivers.

THE WHITAKER PAPER CO., Cincinnati, O., has disposed of a bond issue of $1,500,000, a portion of the proceeds to be used for general operations and expansion.

Property of the NIANTIC & MENHADEN OIL & GUANO CO., East Lyme, Conn., manufacturer of fertilizer products, including real estate, plant and equipment, will be offered at a public sale by a stockholders' committee, headed by Frederick P. Latimer, on Dec. 12.

New Companies

THE MERCURY TANNING CO., Newark, N. J., has been incorporated with a capital of $125,000, to manufacture leather. The incorporators are E. Roth Fast, Jacob and Louis Schrenzel, Newark. The last noted represents the company.

THE L. B. ABEL CO., INC., Waterbury, Conn., has been incorporated with a capital of $50,000, to manufacture rubber products, leather specialties, etc. The incorporators are Frank E. and Louis B. Abel, 118 North Main St., Waterbury.

THE TAYLOR PRODUCTS CO., New York, N. Y., care of M. H. Briggs, 342 Madison Ave., New York, representative, has been incorporated with a capital of $25,000, to manufacture chemicals and chemical by-products. The incorporators are J. E. Taylor and J. D. Peckner.

THE EMPIRE FLUORSPAR CO., Golconda, Ill., has been incorporated with a capital of $100,000, to operate fluorspar properties, refine lead, zinc, etc. The incorporators are Frank H. Stanbitz, Walter R. Pierce and Henry B. Pierce, all of Golconda. The last noted represents the company.

THE PACIFIC STRAW & PAPER BOARD CO., Vancouver, Wash., has been incorporated with a capital of $500,000, to manufacture strawboard, paper board and other composition products. Charles F. Schaub, care of the Chamber of Commerce, Vancouver, is the principal incorporator and represents the company.

THE CLEO MFG. CO., New York, N. Y., care of Rosett & Deutsch, 198 Broadway, New York, representatives, has been incorporated with a capital of $100,000, to manufacture chemicals and affiliated products. The incorporators are C. C. Bleakley, F. Brek and R. Eskin.

THE CELLULOSE CO., Newark Ave., Bloomfield, N. J., has filed notice of organization to manufacture celluloid products. The company is headed by P. Edward Koester, 58 Prospect St., Bloomfield.

THE MICA CERAMICS CORP., Philadelphia, Pa., care of the Capital Trust Co. of Delaware, Dover, Del., representative, has been incorporated under Delaware laws, with a capital of $3,000,000, to manufacture mica products and affiliated specialties.

THE DEARBORN GLASS CO., 1426 West Harrison St., Chicago, Ill., has been incorporated with a nominal capital of $5,000, to manufacture window glass and other sheet glass products. The incorporators are Arthur R. Levisohn and Herman R. Paulick.

THE ALLDAY OIL CORP., Eldorado, Ark., has been incorporated with a capital of $250,000, to manufacture petroleum products. The incorporators are M. L., D. H. and R. E. Allday, all of Eldorado.

THE TUNGSTEN PRODUCTS CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated with a capital of $525,000, under state laws, to manufacture tungsten products and conduct metallurgical operations.

THE CONSUMERS BRICK CO., 607 West 66th St., Chicago, Ill., has been incorporated with a capital of $350,000, to manufacture brick, tile, sewer pipe and kindred burned clay products. The incorporators are Thomas Bisch, Fred C. Rathje and W. L. Woods.

THE HAR-LO PRODUCTS CO., INC., Bridgeport, Conn., has been incorporated with a capital of $50,000, to manufacture varnishes, paints, etc. The incorporators are Harry T., Charles and James E. Logan, and Frederick W. Wren, all of Bridgeport.

THE PREMIER PAPER CO., New York, N. Y., care of S. S. Kogan, 299 Broadway, New York, representative, has been incorporated with a capital of $50,000, to manufacture paper products. The incorporators are S. Greenberg, J. and J. G. Gold.

THE REFUGIO GLASS WORKS, INC., Refugio, Tex., has been incorporated with a capital of $75,000, to manufacture glass products. The incorporators are W. M. Stephenson, W. L. Napier and J. K. Naylor, all of Refugio.

THE EASTERN STEEL CASTINGS, INC., Newark, N. J., has been incorporated with a capital of 20,000 shares of stock, no par value, to manufacture steel and semi-steel castings. The incorporators are John B. Brown, Robert D. Reynolds and William D. Sergent, Ave. L and Edward St., Newark. The last noted represents the company.

THE CHEMICAL ELECTRO PROCESS CORP., Seattle, Wash., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. H. D. Horton, 6022 12th Ave., South, Seattle, is the principal incorporator and represents the company.

THE BON-LAC CORP., 1602 Continental Bldg., Baltimore, Md., has been incorporated with a capital of $25,000, to manufacture shellac, varnishes, etc. The incorporators are James S. Bond, Oliver R. Loomis and W. Fairfield Peterson.

THE BEEBE-TUNNELL CORP., New York, N. Y., care of Newman & Joseph, 291 Broadway, New York, representatives, has been incorporated with a capital of $150,000, to manufacture silicon, aluminum and kindred products. The incorporators are H. Beebe, H. E. Tunnell and B. Simon.

THE ROYAL REFINING CO., care of the Corporation Trust Co. of America, duPont Bldg., Wilmington, Del., has been incorporated under Delaware laws, with a capital of $750,000, to manufacture refined petroleum products.

THE MICHAEL MARX GLASS CO., New York, N. Y., care of Potter & Potter, 305 Broadway, New York, representatives, has been incorporated with a capital of $25,000, to manufacture glass products. The incorporators are I. Sherman, M. Wolfson and N. J. Schumer.

THE STANDARD PAPER CO., San Francisco, Calif., has been incorporated with a capital of $20,000, to manufacture paper products. The incorporators are Charles Gross, David Morris and George R. Perkins, Chronicle Bldg., San Francisco. The last noted represents the company.

Industrial Notes

THE CHEMICAL EQUIPMENT CO., Chicago, Ill., has opened a new office in New York at 109 Broad St., which will be under the supervision of G. M. Hickley, formerly of the Celite Products Co.

THE AMERICAN ANILINE PRODUCTS, INC., has acquired control of the American Vat Color Co. of Chicago and has reorganized it under the name of the American Vat Color Manufacturing Co., with main offices at 80 Fifth Ave., New York City. Ample working capital has been provided. Algol and indanthrene colors are being manufactured.

THE LINK-BELT CO., Chicago, Ill., which for many years has been issuing a large calendar, has just advised that the 1923 Link-Belt calendar will be ready for distribution early in December and that a number of extra copies are available. They can be obtained by addressing the Link-Belt Co., 910 South Michigan Ave., Chicago, on the letterhead of your firm. The calendar measures 15¼x24 in., and contains twelve separate full sheets. Each has an illustration of Link-Belt machinery and equipment. Underneath each month's large calendar are shown the previous month and the succeeding month. The company also announces the promotion of W. W. Sayers to the position of chief engineer of the company's Philadelphia works and Eastern operations. Mr. Sayers was for many years a representative of the company in its Chicago territory, in the lines related to power house machinery, coal storage, Peck carriers, crushers, etc., and later in charge of the locomotive crane department. His headquarters will be at the Philadelphia office.

THE STANDARD TURBINE CORP., of Wellsville, N. Y., announces the appointment of E. E. Maher as district sales manager in Chicago, with offices at 2237 Insurance Exchange Bldg. The Chicago office will handle business for the greater part of Indiana, Illinois and Iowa. The Standard Turbine Corp. is incorporated under the laws of New York and manufactures steam turbines exclusively. J. Y. Dahlstrand, formerly associated in engineering capacities with the Allis-Chalmers Mfg. Co., the Westinghouse Electric & Mfg. Co. and the Kerr Turbine Co., is chief engineer and manager of the corporation.

THE FLORANDIN EQUIPMENT CO., 110 West 40th St., New York City, who is New York representative of the Conveyors Corp. of America, Chicago, is also representing the Perfection Grate & Supply Co., Springfield, Mass., manufacturer of hand stokers and soot cleaners.

JENKINS BROS., New York, announce the appointment of William G. LeCompte as sales manager in charge of their New York territory. Mr. LeCompte has been a member of the sales organization of this company for a quarter of a century.

THE NATIONAL FOREIGN TRADE COUNCIL, of India House, Hanover Sq., New York, announces the completion of a Selected Bibliography of Foreign Trade, 1922, in which are listed the leading authorities on various aspects of International Commerce. This 5-ft. bookshelf of foreign trade contains fifty titles dealing with training for foreign trade, the history and geography of foreign trade, the practical administration of an export business, and with all phases of ocean transportation. "We receive many requests for the titles of books on foreign trade which may be termed the leading authorities," says O. K. Davis, secretary of the National Foreign Trade Council. "To meet this demand, we have consulted a large number of representative economists, editors, educators and practical export executives in order to obtain a consensus of opinion as to which are the best books in the English language on foreign trade. The American literature of foreign trade, which was little better than nothing 10 years ago, has now grown to such proportions that a full list of titles would include several hundred books. It is obviously impossible for business men or those other than academic students of the subject to make practical use of such a list, but there is a desire and a need among those actively engaged in one or another of the different branches of overseas commerce for a brief list of authoritative references. It is primarily to meet that need that this list has been prepared. It has been impossible to include many books of recognized value; but failure to include them indicates only that other works were preferred by those consulted. Should this Selected Bibliography prove of value, the National Foreign Trade Council plans to republish it annually with such changes and additions as further investigation and the publication of new books may necessitate."

THOMAS J. KEENAN, secretary-treasurer of the Technical Photographic and Microscopical Society, has moved from 251 West 19th St., to a more central and convenient location in Room 710, Bar Bldg., 36 West 44th St., New York City.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN ENGINEERING COUNCIL, executive organ of the Federated American Engineering Societies, will meet in Washington, D. C., Jan. 11 and 12, 1913.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its winter meeting at Richmond, Va., Dec. 7 to 9. Headquarters will be at the Hotel Jefferson.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

NEW JERSEY CLAY WORKERS' ASSOCIATION will hold its annual meeting at the Ceramics Building, Rutgers College, New Brunswick, Dec. 12.

SOCIETY OF CHEMICAL INDUSTRY, American Section, will meet in Rumford Hall, 52 East 41st St., New York City, on Dec. 15.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Dec. 8—American Chemical Society, regular meeting. Jan. 5—American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.